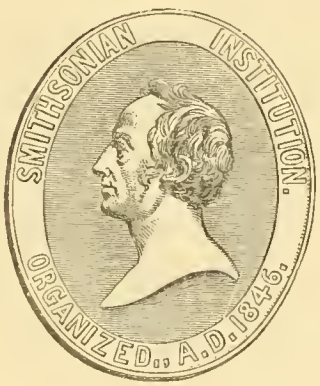
SMITHSONIAN

CONTRIBUTIONS TO KNOWLEDGE.

VOL. XI.



EVERY MAN IS A VALUABLE MEMBER OF SOCIETY, WHO, BY HIS OBSERVATIONS, RESEARCHES, AND EXPERIMENTS, PROCURES KNOWLEDGE FOR MEN.—SMITHSON.

CITY OF WASHINGTON:
PUBLISHED BY THE SMITHSONIAN INSTITUTION.
MDCCCLIX.

SMITHSONIAN
LIBRARY

ADVERTISEMENT.

This volume forms the eleventh of a series, composed of original memoirs on different branches of knowledge, published at the expense, and under the direction, of the Smithsonian Institution. The publication of this series forms part of a general plan adopted for carrying into effect the benevolent intentions of James Smithson, Esq., of England. This gentleman left his property in trust to the United States of America, to found, at Washington, an institution which should bear his own name, and have for its objects the "*increase* and *diffusion* of knowledge among men." This trust was accepted by the Government of the United States, and an Act of Congress was passed August 10, 1846, constituting the President and the other principal executive officers of the general government, the Chief Justice of the Supreme Court, the Mayor of Washington, and such other persons as they might elect honorary members, an establishment under the name of the "Smithsonian Institution for the increase and diffusion of knowledge among men." The members and honorary members of this establishment are to hold stated and special meetings for the supervision of the affairs of the Institution, and for the advice and instruction of a Board of Regents, to whom the financial and other affairs are intrusted.

The Board of Regents consists of three members *ex officio* of the establishment, namely, the Vice-President of the United States, the Chief Justice of the Supreme Court, and the Mayor of Washington, together with twelve other members, three of whom are appointed by the Senate from its own body, three by the House of Representatives from its members, and six persons appointed by a joint resolution of both houses. To this Board is given the power of electing a Secretary and other officers, for conducting the active operations of the Institution.

To carry into effect the purposes of the testator, the plan of organization should evidently embrace two objects: one, the increase of knowledge by the addition of new truths to the existing stock; the other, the diffusion of knowledge, thus increased, among men. No restriction is made in favor of any kind of knowledge; and, hence, each branch is entitled to, and should receive, a share of attention.

The Act of Congress, establishing the Institution, directs, as a part of the plan of organization, the formation of a Library, a Museum, and a Gallery of Art, together with provisions for physical research and popular lectures, while it leaves to the Regents the power of adopting such other parts of an organization as they may deem best suited to promote the objects of the bequest.

After much deliberation, the Regents resolved to divide the annual income into two equal parts—one part to be devoted to the increase and diffusion of knowledge by means of original research and publications—the other half of the income to be applied in accordance with the requirements of the Act of Congress, to the gradual formation of a Library, a Museum, and a Gallery of Art.

The following are the details of the parts of the general plan of organization provisionally adopted at the meeting of the Regents, Dec. 8, 1847.

DETAILS OF THE FIRST PART OF THE PLAN.

I. To INCREASE KNOWLEDGE.—*It is proposed to stimulate research, by offering rewards for original memoirs on all subjects of investigation.*

1. The memoirs thus obtained, to be published in a series of volumes, in a quarto form, and entitled "Smithsonian Contributions to Knowledge."

2. No memoir, on subjects of physical science, to be accepted for publication, which does not furnish a positive addition to human knowledge, resting on original research; and all unverified speculations to be rejected.

3. Each memoir presented to the Institution, to be submitted for examination to a commission of persons of reputation for learning in the branch to which the memoir pertains; and to be accepted for publication only in case the report of this commission is favorable.

4. The commission to be chosen by the officers of the Institution, and the name of the author, as far as practicable, concealed, unless a favorable decision be made.

5. The volumes of the memoirs to be exchanged for the Transactions of literary and scientific societies, and copies to be given to all the colleges, and principal libraries, in this country. One part of the remaining copies may be offered for sale; and the other carefully preserved, to form complete sets of the work, to supply the demand from new institutions.

6. An abstract, or popular account, of the contents of these memoirs to be given to the public, through the annual report of the Regents to Congress.

II. To INCREASE KNOWLEDGE.—*It is also proposed to appropriate a portion of the income, annually, to special objects of research, under the direction of suitable persons.*

1. The objects, and the amount appropriated, to be recommended by counsellors of the Institution.

2. Appropriations in different years to different objects; so that, in course of time, each branch of knowledge may receive a share.

3. The results obtained from these appropriations to be published, with the memoirs before mentioned, in the volumes of the Smithsonian Contributions to Knowledge.

4. Examples of objects for which appropriations may be made:—

(1.) System of extended meteorological observations for solving the problem of American storms.

(2.) Explorations in descriptive natural history, and geological, mathematical, and topographical surveys, to collect material for the formation of a Physical Atlas of the United States.

(3.) Solution of experimental problems, such as a new determination of the weight of the earth, of the velocity of electricity, and of light; chemical analyses of soils and plants; collection and publication of articles of science, accumulated in the offices of Government.

(4.) Institution of statistical inquiries with reference to physical, moral, and political subjects.

(5.) Historical researches, and accurate surveys of places celebrated in American history.

(6.) Ethnological researches, particularly with reference to the different races of men in North America; also explorations, and accurate surveys, of the mounds and other remains of the ancient people of our country.

I. To DIFFUSE KNOWLEDGE.—*It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge not strictly professional.*

1. Some of these reports may be published annually, others at longer intervals, as the income of the Institution or the changes in the branches of knowledge may indicate.

2. The reports are to be prepared by collaborators, eminent in the different branches of knowledge.

3. Each collaborator to be furnished with the journals and publications, domestic and foreign, necessary to the compilation of his report; to be paid a certain sum for his labors, and to be named on the title-page of the report.

4. The reports to be published in separate parts, so that persons interested in a particular branch, can procure the parts relating to it, without purchasing the whole.

5. These reports may be presented to Congress, for partial distribution, the remaining copies to be given to literary and scientific institutions, and sold to individuals for a moderate price.

The following are some of the subjects which may be embraced in the reports:—

I. PHYSICAL CLASS.

1. Physics, including astronomy, natural philosophy, chemistry, and meteorology.
2. Natural history, including botany, zoology, geology, &c.
3. Agriculture.
4. Application of science to arts.

II. MORAL AND POLITICAL CLASS.

5. Ethnology, including particular history, comparative philology, antiquities, &c.
6. Statistics and political economy.
7. Mental and moral philosophy.
8. A survey of the political events of the world; penal reform, &c.

III. LITERATURE AND THE FINE ARTS.

9. Modern literature.
10. The fine arts, and their application to the useful arts.
11. Bibliography.
12. Obituary notices of distinguished individuals.

II. To DIFFUSE KNOWLEDGE.—*It is proposed to publish occasionally separate treatises on subjects of general interest.*

1. These treatises may occasionally consist of valuable memoirs translated from foreign languages, or of articles prepared under the direction of the Institution, or procured by offering premiums for the best exposition of a given subject.

2. The treatises to be submitted to a commission of competent judges, previous to their publication.

DETAILS OF THE SECOND PART OF THE PLAN OF ORGANIZATION.

This part contemplates the formation of a Library, a Museum, and a Gallery of Art.

1. To carry out the plan before described, a library will be required, consisting, 1st, of a complete collection of the transactions and proceedings of all the learned societies in the world; 2d, of the more important current periodical publications, and other works necessary in preparing the periodical reports.

2. The Institution should make special collections, particularly of objects to verify its own publications. Also a collection of instruments of research in all branches of experimental science.

3. With reference to the collection of books, other than those mentioned above, catalogues of all the different libraries in the United States should be procured, in order that the valuable books first purchased may be such as are not to be found elsewhere in the United States.

4. Also catalogues of memoirs, and of books in foreign libraries, and other materials, should be collected, for rendering the Institution a centre of bibliographical knowledge, whence the student may be directed to any work which he may require.

5. It is believed that the collections in natural history will increase by donation, as rapidly as the income of the Institution can make provision for their reception; and, therefore, it will seldom be necessary to purchase any article of this kind.

6. Attempts should be made to procure for the gallery of art, casts of the most celebrated articles of ancient and modern sculpture.

7. The arts may be encouraged by providing a room, free of expense, for the exhibition of the objects of the Art-Union, and other similar societies.

8. A small appropriation should annually be made for models of antiquity, such as those of the remains of ancient temples, &c.

9. The Secretary and his assistants, during the session of Congress, will be required to illustrate new discoveries in science, and to exhibit new objects of art; distinguished individuals should also be invited to give lectures on subjects of general interest.

In accordance with the rules adopted in the programme of organization, each memoir in this volume has been favorably reported on by a Commission appointed

for its examination. It is however impossible, in most cases, to verify the statements of an author; and, therefore, neither the Commission nor the Institution can be responsible for more than the general character of a memoir.

The following rules have been adopted for the distribution of the quarto volumes of the Smithsonian Contributions:—

1. They are to be presented to all learned societies which publish Transactions, and give copies of these, in exchange, to the Institution.

2. Also, to all foreign libraries of the first class, provided they give in exchange their catalogues or other publications, or an equivalent from their duplicate volumes.

3. To all the colleges in actual operation in this country, provided they furnish, in return, meteorological observations, catalogues of their libraries and of their students, and all other publications issued by them relative to their organization and history.

4. To all States and Territories, provided there be given, in return, copies of all documents published under their authority.

5. To all incorporated public libraries in this country, not included in any of the foregoing classes, now containing more than 7000 volumes; and to smaller libraries, where a whole State or large district would be otherwise unsupplied.

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(* Deceased.)

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ARTICLE III. An Account of the Total Eclipse of the Sun on September 7, 1858, as observed near Olmos, Peru. By Lieut. J. M. Gilliss. Pp. 22, and one plate. (Published April, 1859.)

ARTICLE IV. Discussion of the Magnetic and Meteorological Observations made at the Girard College Observatory, Philadelphia, in 1840, 1841, 1842, 1843, 1844, and 1845. Part I. Investigation of the eleven year period in the Amplitude of the Solar-diurnal variation, and of the Disturbances of the Magnetic Declination. By A. D. Bache, LL. D. Pp. 22. (Published November, 1859.

ARTICLE V. Meteorological Observations in the Arctic Seas. By Elisha Kent Kane, M. D., U. S. N. Made during the second Grinnell Expedition in Search of Sir John Franklin, in 1853, 1854, and 1855, at Van Rensselaer Harbor, and other points on the West Coast of Greenland. Reduced and discussed by Charles A. Schott, Assistant U. S. Coast Survey. Pp. 120. (Published November, 1859.)

ARTICLE VI. The Coleoptera of Kansas and Eastern New Mexico. By John L. Le Conte, M. D. Pp. 66, and three plates. (Published December, 1859.)

[1] Each memoir is separately paged and indexed.

ARTICLE VII. Observations on Terrestrial Magnetism in Mexico. Conducted under the direction of Baron von Müller; with Notes and Illustrations of the Volcano Popocatepetl and its vicinity. By August Sonntag. Pp. 92, and one plate. (Published February, 1860.)

ARTICLE VIII. On certain Storms in Europe and America, December, 1836. By Elias Loomis, LL. D., Professor of Natural Philosophy in the University of the City of New York. Pp. 28, and thirteen plates. (Published February, 1860.)

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

NORTH AMERICAN

OÖLOGY.

BY

THOMAS M. BREWER, M. D.

PART I. — RAPTORES AND FISSIROSTRES.

[ACCEPTED FOR PUBLICATION, FEBRUARY, 1856.]

COMMISSION

TO WHICH THIS PAPER HAS BEEN REFERRED.

JOHN GOULD.
JOHN CASSIN.

JOSEPH HENRY,
Secretary S. I.

CAMBRIDGE:
METCALF AND COMPANY, PRINTERS TO THE UNIVERSITY.

INTRODUCTION.

In giving to the public the first number of a paper designed to describe and to illustrate the Oölogy of North America, a few introductory remarks are not inappropriate. The design of the present paper embraces as its legitimate subjects the external shape, size, and markings of the eggs, the nests, or the substitutes for nests, the general habits of the birds peculiar to the breeding season, and their geographical distribution, especially so far as the last may be in connection with their nesting. The internal anatomy of the parent birds, even so far as it may be closely connected with the origin of the subjects of illustration, the formation and development of the egg before expulsion, the chemical peculiarities of the structure of the shell and of its coloring matter, though all closely connected with the subject, are not embraced within its present scope. These are interesting, attractive, and essential connecting links in the history of the propagation of the feathered tribes. They are well worthy of being embraced in investigations that shall reach far beyond any partial researches now on record. They open too wide a field, however, and are quite beyond the means of investigating them at present possessed by the writer.

The paper of which the present number is the commencement is designed to give all that is known to the writer in connection with the subject, derived from his own observations or contributed by the investigations of others. No one is better aware than himself how necessarily deficient his work must be, or that much more remains to be ascertained, and probably will remain, even after his final number shall have been published. For this, however, he does not deem it necessary to apologize, or to offer any other remark than the simple statement that all the facts and knowledge within his reach, or that could be obtained by researches dating back more than twenty years, are here given. He would have been glad could they have been more complete. Having done all that was within his power towards that completion, he can only give according to his present means, and rely upon future investigations to complete that which he has here only begun.

The present Part embraces the descriptions and illustrations of the eggs of the Order *Raptores*, and of the Tribe *Fissirostres* of the Order *Insessores*. So far as he

is at present aware, these include seventy-nine species inhabiting North America. Of these the eggs of no less than twenty are still entirely unknown to him, while of those of eleven others he has no present means of giving illustrations. Besides these deficiencies, it will be observed also that there is not that certainty which is desirable in regard to the illustrations of other eggs the parentage of which is rather probable than positive. To these deficiencies and uncertainties he invites the attention of all of kindred tastes, and solicits their aid and co-operation in supplying as many of these *desiderata* as may be practicable in future numbers, in order that the work may be made more nearly full and complete.

In all instances the illustrations are taken directly from the egg itself, and in none has any attempt been made to make use of drawings. It has been demonstrated by repeated trials, that no drawing of an egg, however skilful may be the draughtsman, can be obtained, in ordinary cases, which gives with sufficient accuracy of light and perspective the shape and markings of the object represented. It has been deemed advisable, therefore, to abandon entirely the original design of including among the illustrations copies of eggs of which access could not be had to the originals. This will materially reduce the writer's present means of illustration, but will render much more complete, uniform, and exact all that he may be enabled to give, while time and future opportunities can hardly fail to supply many of his present deficiencies.

In the following pages acknowledgments are made to the different co-laborers who have kindly contributed to aid him in his work, and to each in connection with the species they have assisted to illustrate. He has endeavored to give full justice to all whose co-operation has extended to those now given, and he trusts that none will find occasion to complain either of omission or of want of due appreciation of their several favors. There are those, however, whose services have been so valuable, whose assistance so constant, so unremitted, or so long continued, and from whose aid and sympathizing interest he has derived so much of encouragement and support, as to call for special mention here and elsewhere.

To John James Audubon, the gifted artist, the ardent and enthusiastic devotee alike of art and nature, the warm-hearted and kindly impulsive man, he must give credit for having been the first to warm into a permanent and enduring aim the earlier germs of interest in this subject. It is to his prompt and opportune sympathy, his generous contributions of materials and of many valuable specimens which would be irreplaceable if lost, that he is indebted for the foundation of his present knowledge, and many of the materials for his task. If, therefore, in the course of the present work, it may be found necessary to give, with that fidelity to exact truth which is the duty of every faithful servant of nature, certain statements and facts inconsistent or in conflict with those of his deceased friend, let it not be supposed that they are presented with any ungrateful lack of appreciation either of his distinguished services to science, or of his many acts of personal kindness. It is hardly possible even for the most exact and cautious to avoid falling into mistakes, and, well aware that he himself may not be found exempt from error, the writer has endeavored, where mention of them could not be avoided, to speak

of them without any imputation of censure, but with that charity for the mistakes of others which he hopes to have meted to himself when occasion shall arise.

To Dr. James Trudeau, hardly less than to Mr. Audubon, acknowledgments must be made for valuable co-operation and assistance. Many years since, almost coincident with his earliest investigations, the design was entertained of a joint work illustrative of American Oölogy. It has only been abandoned in consequence of the continued absence of Dr. Trudeau from the country, the want of knowledge of his present address, and, above all, the fact that no use could be made of the materials jointly collected for the illustrations. To Dr. Trudeau the writer is indebted for a large number of valuable and rare specimens, and for a much larger number of drawings, which are often referred to in the text, but which cannot be made use of in illustrating the present work.

During the past fourteen years, no one has evinced a more constant or more active interest in the subject of the writer's investigations, or contributed more valuable aid, than Professor Spencer F. Baird, of the Smithsonian Institution. The work itself will present, throughout its entire extent, constant evidences of the assistance and co-operation which have been received more or less directly from his zealous and successful endeavors to increase the means of its completeness.

To the venerable John Bachman, D. D., of Charleston, S. C., to John Cassin of Philadelphia, to Dr. A. L. Heermann, now of San Antonio, Texas, to Charles S. Paine of East Bethel, Vt., to Robert Kennicott of West Northfield, Illinois, to Thure Kumlien of Fort Atkinson, Wisconsin, to Samuel Jillson of Lynn, Mass., to John Wolley, Jr., of Beeston, England, to Henry F. Walter of London, besides many others referred to in these pages, the writer is under many and great obligations, without which his undertaking would have been both more onerous and less successful.

In mentioning those to whom special obligation should be acknowledged for important assistance, the author refers with pleasure to the services of Mr. L. H. Bradford, whose ingenious application of photography to the aid of lithography has given valuable results that could have been reached by no other means. The illustrations which are due to his intelligent skill are probably the most perfect representations of eggs that have ever yet been achieved. The credit of this is chiefly due to Mr. Bradford, who has thus greatly contributed to the completeness and value of the work by furnishing illustrations of unsurpassed excellence.

But above all, his acknowledgments are due to the Smithsonian Institution for the aid which it has afforded in the publication and illustration of this work. Without the assistance the author has received from this source, the memoir could not have seen the light, as its cost would have been greater than his own means would authorize, and beyond all probability of remuneration from sales.

It would be too soon, in the present condition of the science, to seek to determine how far Oölogy may ultimately be the means of determining ornithological classification. At present, our knowledge upon this subject is greatly restricted. Only in Europe have any illustrated works upon the local Oölogy been published, and those are chiefly confined to its more northern portions. We have no knowl-

edge of the eggs of more than one tenth of the species of birds ascertained to exist. Those of whole genera, and even families, are comparatively unknown. Yet it is not difficult to see that Oölogy promises to become an important auxiliary both in aiding to determine natural divisions, and to enable us to decide in regard to varieties the specific identity of which is in doubt. Let us take an instance. The Brown Thrush of North America (*Mimus rufus*) is usually classed in the same generic group with the Cat-Bird (*Mimus felivox*). The eggs of these birds are very unlike, and apparently demonstrate that they do not belong together. Without looking at all to the external structure of these birds, Oölogy would seem to indicate that the Cat-Bird, though closely allied to the true Mocking-Bird, is at least one step, and that the Brown Thrush is even farther, removed. If we ask where the former belongs, its eggs point out the Wood Thrush, the Hermit Thrush, and Wilson's Thrush as its nearer kith and kin, with whom it is not usually classed. With the Brown Thrush the case would be even plainer. It would require but a glance at the eggs of the birds of North America, supposing them spread out before us, to satisfy us that, if we accept this test, the Brown Thrush should be counted as a *Toxostoma*, and classed with the *T. curvirostris*, *T. longirostris*, &c., from whose eggs its own could hardly be distinguished.

In regard to the value of Oölogy in determining disputed points of identity of species, the case of *Buteo montanus* may be cited as a striking illustration. Much more might be said upon both these points, but, until more has been learned in regard to the eggs of the birds of all the other parts of the world, it is at least premature to consider how far Oölogy may be taken as a safe guide in classification. As to its value in determining questions of identity or diversity, this cannot well be disputed.

In presenting to the consideration of all interested in the natural sciences the results of his own investigations, largely aided by the co-operation of others, the hope is indulged that it will not be forgotten that the field has been one hitherto unexplored, that all has been new and untried, and that there has been but little in the writings of those who have gone before to lessen the need of his own investigations. Whatever deficiencies may be found in the present pages, and that there must be many is necessary and inevitable, may be remedied in future numbers, if they who may become aware of them will but point them out and supply the means of rectifying them. The co-operation of all interested in the science, throughout the Union, is invited. To those who may add anything to our common stock of knowledge, due credit will be promptly and gratefully rendered.

Boston, April, 1857.

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NORTH AMERICAN OÖLOGY;

BEING AN ACCOUNT OF

THE GEOGRAPHICAL DISTRIBUTION OF THE BIRDS OF NORTH AMERICA

DURING THEIR BREEDING SEASON,

WITH FIGURES AND DESCRIPTIONS OF THEIR EGGS.

PART I.

Order RAPTORES.

Family VULTURIDÆ.

CATHARTES AURA.

Vultur aura, Linn. Syst. Nat. I, 1766, 122.
" " Wilson, Am. Orn. IX. 1814, pl. lxxv, fig. 1.
Cathartes aura, Bonaparte, Synopsis, 1828, p. 22.
" " Richardson & Swainson, Fauna Bor. Amer. II, 1831, 4.
" " Nuttall, Manual, I, 1832, 43.
" " Audubon, Ornithological Biography, II, 1835, 296; V, 339, pl. cli.
" " Bonap. Geog. and Comp. List, 1838, p. 1.
" " Aud. Synopsis, 1839, p. 3.
" " " Birds of America, I, 1840, 15, pl. ii.
" " De Kay, Nat. Hist. New York; Birds, 1844, p. 2, pl. v, fig. 12.
" " Cassin, Synopsis N. A. Birds (Illust. of Birds of California, &c.), 1851, p. 57.
Cathartes septentrionalis, De Wied, Reise, I, 1839, 162.
Vulg. — *The Turkey Buzzard. The Turkey Vulture. John Crow Vulture* (Gosse). *Carrion Crow* (Sloane, Journ. II, 294). *Carrion Vulture* (Latham, Gen. Syn. I, 9). *Vautour du Bresil* (De Buff. Ois. I, 246).

Few birds are more widely distributed through the North American continent than this Vulture. On the Atlantic coast its highest northern migration has been supposed to be southern New Jersey, where it is said to be found throughout the year. A few well-authenticated instances exist of its having been seen on the eastern coast beyond this northern limit,[1] and vague but probably unfounded state-

[1] Catalogue of the Birds of Connecticut, by Rev. James H. Linsley, Silliman's Journal, XLIV, 1843, 250.

ments have been made by writers of its having been met with even in Nova Scotia. West of the Alleghanies it has a much less restricted distribution, from Central America almost to the Arctic regions. It is found more or less frequently in all the Middle, the Southern, Western, and Northwestern States, without probably an exception. It is met with in large numbers throughout the entire Pacific coast of North America, from Lower California to Washington Territory. And until the discovery that the species in South America, which has been regarded as identical with it, is really distinct (*Cathartes jota* of Molina), it was supposed to have an extended South American range. It is not known with certainty whether the *C. aura* is found in South America at all, or whether the species with which it has hitherto been confounded has exclusive possession of that field. Since attention has been drawn to the point, every specimen from that quarter which has been examined proves to be, not the northern, but a distinct and smaller species, of a more uniformly black color.[1] The doubt naturally arises whether the *C. aura* is at all South American, and, until it can be shown positively to be so, it should be excluded from the lists of that region.[2]

The Turkey Buzzard breeds along the entire Atlantic coast, from New Jersey to the Gulf of Mexico, and throughout North America, south of a line extending from the former State to the Pacific, this line reaching farther north as we proceed west. It nests in Cook County, Illinois, (latitude 42° north,) as I learn from the observations of my friend, Robert Kennicott, Esq.[3] David Douglas, possibly not the most undoubted authority, in a letter to Mr. Swainson,[4] mentions seeing "vast numbers of this species in Upper Canada, near Sandwich and Lake St. Clair, in 1823," and implies that they were breeding there at that time. According, also, to Dr. Richardson, its summer migrations are higher in the interior of the continent than on the Pacific coast. He speaks of finding it along the banks of the Saskatchewan, in latitude 55°, late in the month of June. This, however, is stated, not from his own personal observations, but on the strength of a specimen in the Museum of the Hudson's Bay Company, obtained in that neighborhood.[5] Mr. Say observed this species as far to the north as latitude 49°, and

[1] Cassin's Illustrations of the Birds of California, Texas, Oregon, British and Russian America, pp. 57, 58.

[2] Since the above was in type, a few facts have been brought to my knowledge which to some extent seem to favor the impression that the *C. aura* is not a South American bird, or if so, only in occasional instances. It is not found in all the West India Islands. It exists in Cuba, Trinidad, and Jamaica, but is nowhere common, and is unknown in Hayti, as well as in all the intermediate islands of the Caribbean chain. Mr. Richard Hill, an observant naturalist of Spanish-town, Jamaica, in speaking of these facts, writes: "We are no doubt indebted for it to an accidental colony blown over to us from Cuba, and Cuba herself owes it to some stray visitants from the neighboring continent of Florida." Darwin, in the Zoölogy of the Voyage of H. M. S. Beagle (Part III, p. 8), while supposing the *C. aura* and the *jota* of Molina to be identical, notices certain peculiarities in the habits and markings of the South American birds differing from those of the northern species.

[3] Transactions of the Illinois State Agricultural Society, I, 580.

[4] Fauna Boreali-Americana, II, 4.

[5] This is doubted by Mr. Douglas, who suggests that they confounded this species with *C. atratus*. Its correctness is, however, indirectly confirmed by Dr. Gambel, who, in his paper on the Birds of

Lewis and Clarke met them near the Falls of the Columbia River, in latitude 48°. The southern limits of the migrations of the Turkey Buzzard cannot be given with precision. It is impossible to determine how far this species has been mistaken for the *C. jota*, as already stated. It is given by Lembeye and Dr. Gundlach as a resident of Cuba, by Gosse as a bird of Jamaica; it was found by Dr. Cabot in Central America, though not so abundantly as the *C. atratus;* and Darwin, in the Zoölogy of the Beagle, mentions it as having been obtained as far to the south as latitude 55°, even the extreme points of Terra del Fuego, Western Patagonia, and the Falkland Islands. It is, however, probable that the bird of which Darwin speaks is not the *C. aura*, but its kindred species already referred to. How far this is the case with the birds met with by the others named, may admit of some doubt, though the probability is that all the authorities cited refer to the northern species.

The Turkey Buzzard invariably lays on the ground, for the most part in hollow trees, stumps, or decaying logs. It constructs no nest, but deposits the eggs with little or no preparatory pains for their shelter. Mr. Ord found them breeding as early as the month of May, in the deep recesses of the solitary swamps of New Jersey. He describes the nest as formed, without any painstaking, in a truncated hollow tree, and in excavated stumps or logs, and mentions the number of eggs as from two to four. Except in regard to the number of eggs, which is rarely, if ever, more than two, these observations substantially correspond with all the reliable accounts I have seen of their breeding. In Jamaica, Mr. Gosse writes that the situations usually selected by the Turkey Buzzard of that island, for laying and hatching its eggs, are hollows and ledges of rocks, in secluded places or inaccessible crags and cliffs. A little dry trash, he adds, or decaying leaves, are all the apology for a nest. Mr. Audubon mentions, that on the island of Galveston, where this Vulture is plentiful, he several times found its nest, as usual, on the ground, but in an unusual place; namely, on a level part of the salt marshes, either under the wide-spread branches of cactuses, or among tall grass growing beneath low bushes. The eggs which Mr. Audubon obtained at Galveston, and which he supposed to be those of the *C. aura*, have been ascertained unquestionably to belong to the *C. atratus*. It is, therefore, probable that the nests he has described also belonged to birds of the latter species.

Dr. C. Kollock, of Cheraw, South Carolina, informs me that in his neighborhood both this species and the Black Vulture frequent places in the interior of swamps and thick woods, generally called Buzzards' roosts; that they congregate there through the year in large numbers, and usually breed in the immediate vicinity of these places. Mr. Audubon visited one of these roosts, near Charleston, S. C. It extended over two acres of ground, which were entirely destitute of vegetation.

The *eggs* of this species exhibit certain deviations in size, and, occasionally, in their markings, yet for the most part preserve specific characteristics. The

California (Journal of Philadelphia Academy, Second Series, Vol. I.), states that he found *C. aura* as common on the Pacific as on the Atlantic coast.

following are the proportions of four specimens, which will well represent their usual variations: $2\frac{13}{16}$ inches by $1\frac{15}{16}$; $2\frac{12}{16}$ by $1\frac{14}{16}$; $2\frac{15}{16}$ by $1\frac{14}{16}$; $2\frac{10}{16}$ by $1\frac{15}{16}$. These specimens were from New Jersey, South Carolina, Louisiana, and Tamaulipas (Mexico). The more common varieties have a ground of a light cream-color, marked with large confluent spots of reddish-brown or chocolate, chiefly predominating at the larger end, but also sparsely scattered over the entire egg. Intermixed with these are less frequent markings of a light purplish or lilac shade of drab. These are often so faint as only to be perceptible on a close examination. An egg taken some years since in New Jersey, by Alexander Wilson, and which perhaps is somewhat faded from its original colors, is marked over the entire shell with confluent spots of a dark greenish-brown, but with no perceptible shades of red or purple. Another variety from Cheraw, S. C. (fig. 2) has a ground of nearly pure white, is very nearly unspotted, and is only marked with a few small dots and lines of red and indistinct purple at the larger end.

CATHARTES ATRATUS.

Vultur jota, Gmel. Syst. Nat. I, 1788, 247.
" " Wils. Amer. Orn. IX, 1814, pl. lxxv, fig. 2.
Vultur atratus, Bartram's Trav. 1791, p. 289.
Vultur urubu, Vieill. Ois. d'Am. Sept. 1807, p. 53, pl. ii.
Cathartes jota, Bonap. Syn. 1828, p. 23.
" " Nuttall, Manual, I, 1832, 46.
" " Aud. Orn. Biog. II, 1835, 33; V, 345, pl. cvi.
" " Bonap. Geog. and Comp. List, 1838, p. 1.
Cathartes atratus, Rich. & Swains. Fauna Boreali-Americana, II, 1831, 6.
" " Aud. Syn. 1839, p. 3.
" " " Birds of America, I, 1840, 17, pl. iii.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 58.
" " " Birds of Gilliss's U. S. Nav. Ast. Ex. II, 1855, 173.
Vulg. — *The Carrion Crow. The Black Vulture. Jotecillo. Gallinazo.*

The distribution of this species, though perhaps less extended in North America than that of the preceding, is yet over a wide extent of territory. Along the southern and southwestern coast of the United States, from North Carolina to Mexico, it is very common. West of the Rocky Mountains it is said to be abundant,[1] and to be found as far to the north as Oregon Territory. We have the authority of Mr. David Douglas[2] for its visiting the marshy islands of Columbia River, and the banks of Lewis and Clarke's River, latitude 45° – 49° north. Mr. Audubon has

[1] Later investigations do not confirm its abundance on the Pacific; and it is a noticeable fact, that, in the numerous collections of birds made on the western coast of North America within the last few years, there are no specimens of *C. atratus*.

[2] Fauna Boreali-Americana, II, 4.

stated that it was found as far to the north, on the eastern coast, as Maryland. If so, its occurrence must be very rare, and I can find no satisfactory confirmation of the statement.[1] It is not often met with farther north than Wilmington, N. C. At Norfolk, Va., if occurring at all, it has not been distinguished from the Turkey Buzzard; for I was unable to find any one who had met with this Vulture there, to his knowledge, though familiar with the bird itself. Along the coast of all the Southern States, from North Carolina to Texas, it is much more abundant than its kindred species, even where, in the interior of the same State, it is far less frequent. Along the banks of the Mississippi and its tributaries, as far as Ohio to the east and Illinois to the north, it is found more or less abundantly, at certain seasons. Dr. Gambel met with it in great numbers on the Pacific coast of California,[2] and Dr. S. Cabot, Jr. found it the most prevalent species in Central America.

As to what its extreme southern limits may be, the same doubts arise as in regard to those of the preceding, because in South America it has been, until very recently, confounded with a smaller and quite distinct species,[3] *Cathartes brasiliensis*. It is not as yet possible to determine to what extent this species occurs in that region, or how far writers, in speaking of the *C. atratus*, have had in view only that for which it has been mistaken. Mr. Cassin, however, informs me that he has seen a specimen of the real *C. atratus* from Peru, and specimens were also brought by Lieutenant Gilliss from Chile, obtained near Santiago, where it was not common, and only found in the mountainous regions of the interior. Darwin fixes its extreme southern limit in latitude 41° south, near the Rio Negro,[4] and he did not meet with it in Chile or Patagonia.

In the Southern Atlantic cities, especially Charleston and Savannah, the Black Vulture, or Carrion Crow, as it is as frequently called, is a semi-domestic bird, and is very abundant. It is also to be found in the interior, but is neither so common nor so tame. It breeds on or near the ground, in the same manner as the Turkey Buzzard, in hollow logs, decayed trunks of trees, and stumps, and also without this protection, the bare earth only being made use of. It makes no nest.[5] The eggs seldom if ever exceed two in number. These are greater, both in their length and capacity, than those of the Turkey Buzzard, although the measurements of the birds themselves would seem to show the latter to be apparently the larger of the two, its length being 32 inches, and that of *C. atratus* but 26. As, however, the average weight of the Carrion Crow is about one pound, or fifteen per cent, greater than that of the Buzzard, this superiority in the eggs of the *C. atratus* ceases to seem anomalous.[6] Three eggs, from Charleston, Galveston, and the Rio Grande, furnish the

[1] An accidental specimen of the Black Vulture was obtained in Swampscot, Massachusetts, November, 1850, by Mr. S. Jillson, of Lynn, a diligent and reliable ornithologist.

[2] Journal of Philadelphia Academy, Second Series, I, 26.

[3] Cassin's Birds of California, &c., p. 59.

[4] Darwin's Zoölogy of the Beagle, Part III, p. 7.

[5] The statement of Mr. Abbott of Georgia, that this Vulture breeds on trees, is not well founded. No well-authenticated instance is known.

[6] The length of a bird cannot always be taken as a safe guide in determining the probable size of its egg. Much depends upon the shape and relative capacity of the pelvis, and much also upon the

following measurements: $3\frac{4}{16}$ inches by $1\frac{15}{16}$; 3 by $2\frac{1}{16}$; $3\frac{1}{16}$ by $1\frac{15}{16}$. The principal difference between the eggs of this and the preceding species is in regard to their size. Their ground color is the same, or nearly the same: a yellowish-white or cream-color, almost never a pure white, and if so, only in exceptional cases. The eggs are more elongate in their shape, and the blotches are usually larger. These are of a dark reddish-brown, confluent and chiefly distributed around the larger end. There are also markings or dashes, smaller and less frequent, of lilac and purplish drab, similar to those noticed in the eggs of the *C. aura*. An egg from the Rio Grande is marked with small spots of reddish-brown and faint lilac, equally distributed over the whole surface on a ground of cream-color. This is very peculiar, and probably not a common variation from the more usual markings of the eggs of this Vulture. The more common markings of this egg are well represented in fig. 3. The specimen was obtained by Audubon on Galveston Island, Texas. Fig. 4 represents a less common variety, obtained by Dr. Kollock in Cheraw, S. C.

CATHARTES CALIFORNIANUS.

Vultur californianus, Shaw, Nat. Misc. IX, 1797, 1, pl. ccci.
Vultur columbianus, Ord, Guthrie's Geog. II, 1815, 315.
Cathartes vulturinus, Temm. Pl. Col. I, 1820, pl. xxxi.
Cathartes californianus, Bonap. Syn. 1828, p. 22.
" " Nuttall, Manual, I, 1832, p. 39.
" " Aud. Orn. Biog. V, 1838, 240, pl. ccccxi.
" " Bonap. Geog. and Comp. List, 1838, p. 1.
" " Aud. Syn. 1839, p. 2.
" " " Birds of Am. (8vo.) I, 1840, 12, pl. i.
" " Gray, Gen. of Birds, 1849, pl. ii.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 58.

Vulg. —*The Californian Vulture. The California Turkey-Buzzard.*

But one instance of the possession of a well-authenticated egg of this species by a naturalist has come to my knowledge. This was one laid in confinement by a female belonging to the Garden of Plants in Paris. An accurate drawing of this was taken by Dr. James Trudeau, and is now in my possession. There seems no reason to doubt that the egg thus laid does not essentially vary from those deposited in a wild state. It certainly is hardly possible that the variations between this and the natural egg can be so total and striking, as between it and the attributed

degree of development possessed by the young bird when first hatched. Birds whose young are hatched in an advanced stage of maturity, and can shift for themselves from the egg, like many species of shore-birds, the Uriæ and others, have invariably proportionately very large eggs, and *vice versa*, except only where the female deposits a large number, as in the case of the Wild Turkey, the Virginia Quail, the Ruffed Grouse, and many others.

shape and markings of the eggs of this species, if we credit the previous accounts which have been given of the eggs of the Californian Vulture. These descriptions are, however, all traceable to one source, so far as I am aware. David Douglas, in the Zoölogical Journal, speaks of the eggs of this Vulture as nearly spherical, *jet-black*, and about the size of those of a Goose. Following this authority, all writers who have referred to the eggs of the Californian Vulture have described them in a similar manner. That they should be spherical would be an exceptional case to the whole genus, and is therefore hardly probable, though by no means impossible. Markings of a jet-black color, even to the extent of blotches, spots, or lines, are of very rare occurrence, if not positively unknown. Nor am I aware that any of this family of Vultures ever construct nests. For these reasons, and until the statements of Mr. Douglas can be confirmed by other testimony, I am inclined to discredit his accounts of its nest, eggs, and habits, in every respect.[1] In this unbelief I am in part confirmed by the testimony of Mr. Townsend. He was informed, as he tells us, by the Indians of the Columbia River, that the Californian Vulture, like all others of its genus, breeds on the ground, fixing the place for a nest in swamps, under the pine forests, chiefly in the alpine country, — in this conforming with the habits of the family.

The egg in the Garden of Plants corresponds, in its generic characteristics, with the eggs of the *Cathartes aura*, the *C. atratus*, and also with those of the *jota* and *brasiliensis* of South America. It is also remarkably similar, except in size, to occasional marked varieties of the egg of the Condor (*Sarcoramphus gryphus*), which, however, is usually white and unspotted. I feel justified, therefore, in accepting the drawing as an authentic representation of those of this species.

This egg measured $3\frac{14}{16}$ inches in length by $2\frac{12}{16}$ in its greatest breadth. Its ground color is that of all the known eggs of this genus, a rich cream-color, or a yellowish-white. A ring of reddish-brown confluent blotches surrounds the larger end, leaving the residue nearly free from markings. A few blotches of a smaller size and lighter color are distributed over the whole surface. The faint purplish-drab markings noticeable in the eggs of the preceding species are not observable in this specimen.

The Californian Vulture is confined to the western slope of the Rocky Mountains. It is there found from the extreme southern portions of the Pacific coast of North America to Washington Territory and the British possessions, where it abounds in the summer season. It was met with by Mr. Townsend on the banks of the Columbia, upwards of five hundred miles above the mouth of that river, throughout the months of June, July, and August.

[1] "They build in the most secret and impenetrable parts of the pine forests, invariably selecting the loftiest trees that overhang the precipices on the deepest and least accessible parts of the mountain valleys. The nest is large, composed of strong thorny twigs and grass, in every way similar to the nests of the Eagle tribe, but more slovenly constructed. The same pair resort for several years to the same nest, bestowing little trouble or attention in repairing it. They lay two nearly jet-black eggs, about the size of those of a Goose. They hatch generally about the 1st of June, and the period of incubation is twenty-nine or thirty days." (David Douglas, Zoölogical Journal.)

Family FALCONIDÆ.

FALCONINÆ.

FALCO ANATUM.

Falco peregrinus, Wils. Am. Orn. IX, 1814, 120, pl. lxxvi.
" " Bonap. Syn. 1828, p. 27.
" " Rich. & Swain. F. B. A. II, 1831, 23.
" " Nutt. Man. I, 1832, 53.
" " Aud. Orn. Biog. I, 1832, 85; V, 365, pl. xvi.
" " " Syn. 1839, p. 16.
" " " Birds of Am. I, 1840, 84, pl. xx.
" " De Kay, Nat. Hist. New York, I, 1844, 13, pl. iii, fig. 8.
" " Lembeye, Birds of Cuba, 1850, pl. i, fig. 2.
Falco anatum, Bonap. Geog. and Comp. List, 1838, p. 4.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 86.

Vulg. — *Great-footed Hawk. American Peregrine Falcon. Blue-backed Falcon. Spotted Falcon. Haggard Falcon. Duck Hawk.*

The amount of exact information in our possession in regard to the distribution of this species during the breeding season, its geographical range generally, its manner of breeding, or the extent of the variations to which its eggs may be subject, is much more limited than could be wished. To some extent this is owing to this species having been so long confounded with the Western Peregrine (*Falco nigriceps*, Cassin) of California, but yet more so to its restriction, during the breeding season, to less frequented and high northern latitudes, where it has been rarely met with by naturalists. But one well-authenticated instance has come to my knowledge of its having been met with, during the breeding season, south of Newfoundland. At other seasons it has been found throughout the entire American continent, unless we are to suppose that its near relatives, the two Californian species, may have been mistaken for this bird in the instances referred to. It preys chiefly upon sea-ducks, and therefore is, for the most part, met with on the coast, is rarely found inland, and its migrations and wanderings are influenced by the flights of its favorite game. It has been found, at various seasons, throughout the entire eastern coast of North America, and possibly belongs to the western also; but this remains to be ascertained. Mr. Gosse obtained it in Jamaica, and Lembeye and Dr. Gundlach in Cuba. Sir William Jardine assigns it to Bermuda, and a species supposed, though perhaps erroneously, to be the same, has been observed in the Straits of Magellan. The last, however, may have been either the Californian, the Australian,[1] or an undescribed species.

[1] The Australian species, once confounded with the Peregrine Falcon of Europe, is now recognized as distinct. It is the *Falco melanogenys* of Gould's Birds of Australia. This bird, like all of its kindred

I was not, until very recently, aware that this species had ever been known to breed within the United States. Mr. Audubon inferred it from meeting with specimens near Niagara Falls, in the month of August; but their mere occurrence in that locality so late in the season as August is not conclusive evidence of their having been hatched in that neighborhood. Mr. Ord, in his addition to Wilson, stated that this Hawk breeds in the swamps of New Jersey; but though diligently sought for, their nests have never been found, and the statement is probably incorrect. Nor is there apparently any good foundation for the impression Mr. Ord seems to have been under, that they nest on trees. Certainly there is no satisfactory evidence of this fact, or nothing beyond vague and unsupported reports. Sir John Richardson, in his Arctic searching expedition, in 1845, while descending the Mackenzie River in latitude 65° north, noticed a Peregrine nest, supposed to be one belonging to a bird of this species, placed on the cliff of a sandstone rock. He also speaks of this Falcon as not rare on that river, where it preys on the Passenger Pigeons and smaller birds. Dr. Gambell speaks of its occurrence on the sea-coast of California, and of its there nesting on the cliffs, but he has probably mistaken for it the common species of that country.[1]

and closely assimilated species, breeds on the rocky cliffs of the sea-coast of Australia. Its eggs are two in number; their ground color is buff, but this is scarcely perceptible from the predominance of the blotchings of deep reddish-chestnut with which it is marbled all over. They are two inches and one line long by one inch and seven and a half lines broad. It is highly probable that the South American bird referred to above will prove to be yet another distinct member of this interesting and closely connected group.

[1] Since writing this article, I have been informed by Professor S. F. Baird that this Hawk undoubtedly nested on a high cliff near the house of Professor S. S. Haldeman, near Columbia, Pennsylvania, as attested by the assurances of Professor Haldeman, who has on several occasions procured very young ones which had fallen from the nest. Specimens of these are in the Smithsonian Institution. Professor Haldeman, in answer to my inquiries, has kindly furnished me with the following interesting information in regard to the occurrence of this bird in Pennsylvania: "In the Proceedings of the Academy of Natural Sciences, Vol. I. p. 54, (1841,) I have noticed the occurrence of *Falco peregrinus* (*anatum*) on the Susquehanna. A pair had a nest for many years about a hundred yards from my house, on a high and almost vertical cliff; but as a railway now traverses its base, it is not probable that the species will return to the locality. I have not seen an individual for a number of years past. Without direct comparison, I regarded this as the European bird; and I suspect that, in giving it the name of *F. anatum*, Bonaparte was guided by the supposed difference in the habits. Had I known that any one had a doubt on the subject, I would have collected the material placed within my reach; and having failed to do so, I must now depend upon an uncertain recollection. This bird remained ten or eleven months in the year, disappearing only in the coldest weather, and returning with the first favorable change. The nest was difficult of access, and I never saw it; but it was once reached, and the young taken, by getting down from above. I have seen them at Harper's Ferry since the railway has been in use there, recognizing them by their flight and cry. I feel confident that they breed there, the cliffs being well adapted to their habits. Ranges of similar cliffs occur along the rivers of East Tennessee, but I did not meet with the bird when travelling there. On the Susquehanna they breed early in spring, the young (to the number of *not less* than three) leaving the nest perhaps in May; and there may possibly be a second brood. I used formerly to see this species about three miles farther up the Susquehanna, where it probably inhabits the cliffs on the western side. I will endeavor to discover whether they are still there, and if so, will set some inquiries on foot as to the probability of getting the eggs. I am under the impression that at my locality but a single pair remained, the young disappearing in the course of the season. In the wild region between Columbia and tide-water, there are many localities suited to the habits of this bird."

My knowledge of the markings of the eggs of the Great-footed Hawk is limited to two specimens, one of which is represented in the plate (fig. 11). The other is a drawing taken by Dr. Trudeau from an egg obtained in Labrador. It closely resembles a variety of the eggs of the European species, but seems to present differences sufficiently well marked to be regarded as specific. It measures two inches in length by $1\frac{9}{16}$ in breadth. The ground colors of both American and European are a reddish-yellow, and both are thickly covered with fine dottings of chocolate and ferruginous-brown, diffused over the whole egg, in nearly equal degree, and to such an extent as nearly to conceal the ground. The length of the American egg is slightly less, but it is of equal or greater capacity, and varies in its markings from all the European specimens that I have ever met with. These variations, though readily traceable by the eye, are not so easily described. The shades of coloring in both are closely alike; the variation consists more in the distribution of these markings. In the European specimens, the fine markings of chocolate are distributed with nearly exact uniformity. In the American, the secondary colorings are now more thickly and now more thinly diffused, here leaving the ground color nearly unchanged, there becoming confluent and blending into waving lines, blotches, and bold dashes. The egg, in consequence, presents a more variegated appearance. These markings are also in greater proportion around the larger end of the egg, and the blotches are of a deeper shade, so that there is a variation in the shadings between the smaller and larger extremities, not noticeable in any European eggs that I have met with.

Fig. 11 represents an egg to my mind undoubtedly of this species, but not certainly ascertained, because the difference of species between the American and European bird was not recognized by the donor. It is from Greenland, and was given me as that of *Falco peregrinus*, where, however, the *F. anatum* is supposed to replace the true Peregrine.

HIEROFALCO SACER.

Falco sacer, Forster, Phil. Trans. London, LXII, 1772, 423.
Falco fusca, Fabricius, Fauna Groenlandica, 1780, p. 56.
Falco cinereus, Gmelin, Syst. Nat. I, 1788, 267.
Falco islandicus, Rich. & Swain. F. B. A. II, 1831, 27.
" " Nuttall, Manual, I, 1832, 51.
" " Aud. Orn. Biog. II, 1835, 552; IV, 476, pl. cxcvi.
" " " Syn. 1839, p. 15.
" " " Birds of Am. I, 1840, 81, pl. xix.
Falco labradora, Aud. B. of A. 1834, pl. cxcvi.
Falco gyrfalco, Bonap. Geog. and Comp. List, 1838, p. 4.
Falco candicans, Bonap. Cons. Av.
Hierofalco sacer, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 89.
Vulg. — *American Gyrfalcon. The Greenland Falcon. American Jerfalcon. Iceland Falcon.*

Very little is with certainty known in regard to the geographical distribution, nesting, and habits of this species. Like the preceding, it has, until very recently, been confounded with one closely allied, and even now we can only infer, rather than be said to know, all that is attributed to it. It is unquestionably specifically distinct, in my opinion, from the *H. islandicus;* and as no specimens of the latter are known to have been obtained nearer this continent than Greenland, and as *H. sacer* is not found in Europe, it is presumed, though possibly on insufficient grounds, that one bird is exclusively American, and the other as exclusively confined to Iceland and the old continent.[1] The extreme northern range of the two birds makes it by no means improbable that both are found throughout the entire Arctic circle, and are not restricted to either continent.

The *H. sacer* is rarely met with in the United States, and only in midwinter, but is not unfrequent in the more northern regions of North America, and throughout Greenland. Richardson speaks of it as a constant resident in the Hudson's Bay territories. He supposed its extreme southern latitude to be 52° north. It was observed by Captain Sabine on the west coast of Greenland, as far north as 74°. Sir John Richardson found a nest of this bird in June, 1821, built on a lofty precipice on the borders of Point Lake, in latitude 65½°. Mr. Audubon also speaks of finding a nest of the present species near Bras-d'or in Labrador, placed on high rocks, fifty feet from their summit, and more than one hundred from their base. It was composed of sticks, sea-weeds, and mosses, about two feet in diameter, and almost flat. I have in my possession the drawing of an egg from Labrador, which was taken by Dr. James Trudeau, and is, so far as I am aware, the only authentic representation of the egg of this species which has been obtained on our continent. It differs essentially from all the European specimens I have seen, but corresponds very closely

[1] Since the above was written, the publication of a paper read before the Philadelphia Academy in February, 1855, by Mr. Cassin, in part confirms my conjecture that these species are not restricted to either continent. Certainly *H. islandicus* is not. At the same time, this accurate ornithologist appears less confident of the distinctness of the two species, and is not without a suspicion of their identity.

with one from Greenland, in the collection of the Philadelphia Academy (fig. 12). If these variations are specific, as I presume they are, the eggs belonging to Mr. Yarrell, described by him as those of the European species (*H. islandicus*), are probably those of the American bird. The same were figured by Mr. Hewitson; and as neither of these naturalists recognizes the two Hawks as distinct species, they were not likely to be on their guard in reference to any specific variations in their eggs. In European collections, the eggs of both species have been confounded with each other, all passing as undoubted eggs of *H. islandicus*, precisely as those of the American Fish-hawk (*Pandion carolinensis*) are unwarrantably confounded with those of the European Osprey (*Pandion haliætus*), and the two are even regarded as identical in Hewitson's Oölogy.

The egg of the *H. sacer* is slightly larger than that of the *H. islandicus*, and the predominant color of its markings is a deep reddish-brown, very generally and nearly equally diffused over its surface, concealing the ground color, which is lighter, and with a more yellowish shade. Its measurement is $2\frac{6}{16}$ inches in length by $1\frac{13}{16}$ inches in breadth.

Two specimens of the egg of *H. islandicus*, one from Norway and the other from Iceland, measure, the first $2\frac{7}{16}$ by $1\frac{13}{16}$, the latter $2\frac{6}{16}$ by $1\frac{13}{16}$ inches. In both, the ground color is a dirty yellowish-white. One is marked with spots, dottings, and confluent blotches of yellowish-brown, interspersed with a few dashes of dark brown in an increased proportion about the larger end. The other is marked in like manner with light yellowish-brown, but much more sparingly, and so slightly and uniformly, that, unless closely examined, it would seem to be of one uniform color, and that a light brown, shaded with yellow.

HYPOTRIORCHIS COLUMBARIUS.

Falco columbarius, Linn. Syst. Nat. I, 1766, 128.
" " Wils. Am. Orn. II, 1810, pl. xv, fig. 3.
" " Bonap. Syn. 1828, p. 38.
" " Rich. & Swains. F. B. A. II, 1831, 35.
" " Nuttall, Manual, I, 1832, 60.
" " Aud. Orn. Biog. I, 1832, 466; V, 368, pls. lxxv and xcii.
" " Bonap. Geog. and Comp. List, 1838, p. 4.
" " Aud. Syn. 1839, p. 16.
" " " Birds of Am. I, 1840, 88, pl. xxi.
" " De Kay's Nat. Hist. N. Y. I, 1844, 4, pl. iv, fig. 9.
Falco intermixtus, Daudin, Traité d'Orn. II, 1800, 141.
?? *Falco æsalon*, Rich. & Swains. F. B. A. II. 1831, 37.
Falco temerarius, Aud. Orn. Biog. I, 1832, 381, pl. lxxv.
Vulg. — *The Pigeon-Hawk. Little Corporal Hawk. L'Epervier de la Caroline* (Briss.).

It was at first my intention to omit at present giving any plate representing the egg of this species, for the reason that I have been unable to decide with certainty

between two claimants to be so regarded. These are each with so very nearly equal pretensions, that at times I have been strongly inclined to give alternately the one or the other as genuine. Yet they are very distinct, and it is not possible they can be varieties belonging to the same species. One of these was obtained in the Two Islands, a group near Grand Menan, in the Bay of Fundy. This had been obtained a few days before it came into my possession. The remains of a bird, which I was told was the parent, were unmistakably those of this species. This egg measures $1\frac{13}{16}$ by $1\frac{7}{16}$ inches, and is nearly spherical. Its ground color is a not very clear white, and is marked by a few bold dashes of a light yellowish-brown, distributed irregularly, but chiefly about the smaller end. There were four eggs in the nest. The latter was coarsely constructed, as I was informed, of sticks and mosses, and resembled that of a crow. The size of this specimen seems disproportionately large for the bird. It corresponds, however, very closely with the description of the eggs of this Hawk given in Hutchins's Notes on the Birds of Hudson's Bay.[1] This egg is represented, Plate 10, fig. 35.

On the other hand, I have a copy of Mr. Audubon's drawing taken from the contents of a nest which he was confident was that of the *H. columbarius*. This is very different in size, shape, and markings. It measures $1\frac{11}{16}$ by $1\frac{3}{16}$ inches, its shape is an oblong oval, and it is so thickly covered with deep blotches of chocolate that its ground is entirely concealed. Mr. Audubon refers to the discrepancy between Mr. Hutchins's description and his own observations,[2] and appears to have been very positive that the eggs which he found in three different instances were those of this Hawk. As, however, I have known instances in which even Mr. Audubon has been mistaken, when apparently feeling equally confident, I have hesitated to adopt his drawing, until it can be verified, or the other egg ascertained to belong to a different species. My own supposition is that my egg from Grand Menan is genuine, and that Mr. Audubon's drawing may be that of an egg of the Sharp-shinned Hawk (*Accipiter fuscus*).

The Pigeon-hawk is distributed, in the breeding season, throughout the northern parts of North America. It breeds as far to the south as Maine on the Atlantic coast, and California on the Pacific. At other seasons it ranges over the entire continent, and extends its wanderings to Cuba, Jamaica, and the northern parts of South America. I have received a specimen from Wisconsin, where it possibly breeds.

[1] Mr. Hutchins, in his Notes on the Hudson's Bay Birds, informs us that this species "makes its nest on rocks and in hollow trees, of sticks and grass lined with feathers, laying from two to four white eggs, thinly marked with red spots." (Fauna Boreali-Americana, II, 36.) On the next page, Richardson, speaking of his *Falco æsalon*, which, however, was really a variety of the *H. columbarius*, says: "In the oviduct there were several full-sized white eggs clouded at one end with a few bronze-colored spots," — a description much more nearly corresponding with the egg from Grand Menan than with Mr. Audubon's drawing and description.

[2] "Mr. Hutchins's description of the eggs of this bird is greatly at variance with my own observations. The eggs, in three instances which occurred at Labrador, were five; they measured an inch and three quarters in length, an inch and a quarter in breadth, and were rather elongated; their ground color a dull yellowish-brown, thickly clouded with irregular blotches of dull dark reddish-brown." (Birds of America, 8vo, I, 88, 89.)

Mr. Gosse speaks of it as a constant resident of Jamaica,[1] and Mr. Nuttall supposed it to nest in the Southern States.[2] Both are probably mistaken. In every instance where I have heard of the Pigeon-hawk as a summer resident, south of Maine, it has proved to be the Sharp-shinned Hawk (*Accipiter fuscus*). Dr. Gambel found it abundant on the coast of California, Sir John Richardson met with it in latitude 57° north, and again probably in 66°, and M. de Sagra, Lembeye, and Dr. Gundlach mention it as a visitant of Cuba.

HYPOTRIORCHIS FEMORALIS.

Falco femoralis, Temm. Pl. Col. I, 1827, Livraison 58, pl. cxxi (males); pl. cccxliii (adult male).
" " Darwin, Zoölogy of the Beagle, 1838, Part III, p. 28.
Harpagus bidentatus, Gay, Fauna Chilena, 1847, Aves, p. 230.
Hypotriorchis femoralis, Cassin, Birds of Gilliss's U. S. Nav. Ast. Ex. II, 1855, 177.
Vulg. — *Alcou* or *Halcou*.

This handsome species rests its claims to be regarded as a North American, as well as a South American bird, at present, upon a single specimen, obtained in New Mexico by Dr. A. L. Heermann. This was a fine adult bird, in regard to the identity of which there can be no question. It was at first supposed by its discoverer to be a new and undescribed species, and its identity with Temmink's *F. femoralis* was closely scrutinized. No other specimens, that I am aware of, have been obtained in North America.

Mr. Darwin, in his Zoölogy of the Voyage of the Beagle, mentions obtaining one specimen in a small valley on the plains of Patagonia, at Port Desire, in latitude 47° 44′ south. This would seem to exhibit for this Hawk the unusually extended geographical range of at least eighty degrees of latitude. M. D'Orbigny supposed that latitude 34° was the extreme southern limit of this species. In this he was clearly very much in error. Besides the instance just mentioned, I am assured by Mr. N. H. Bishop that he found this bird very abundant throughout the Pampas of southern South America, in about latitude 38° south, and Lieutenant Gilliss also brought specimens from Chile.

According to Mr. Darwin, the *H. femoralis* builds its nest in low bushes. This corresponds with the observations of Mr. Bishop. Mr. Darwin also states that he found the female sitting on her eggs in the beginning of January. He describes the eggs he found as "one eighth of an inch in longer diameter, and one fourth of an inch in shorter; surface rough with white projecting points; color nearly uniform dirty wood-brown, thickly freckled with rather a darker tint; general appearance as if it had been rubbed in brown mud." This description is not exact, and does not convey a very correct idea of the specimens in my possession.

[1] The Birds of Jamaica, p. 19.

[2] Nuttall's Manual, I, 60.

M. D'Orbigny states that the *femoralis* prefers a dry, open country with scattered bushes, which Mr. Darwin confirms. Mr. Bishop also informs me that he met with this Hawk in the greatest abundance upon those vast plains of South America known as the Pampas, in which no trees except the ombû are found, and that it there nests exclusively on the tops of low bushes hardly more than a foot or two from the ground. The bird is not at all shy, like most Hawks, but is easily approached so nearly as to be readily recognized.

Mr. Bridges states, in the Proceedings of the London Zoölogical Society (1843, p. 109), that the *H. femoralis* is trained in some parts of South America for the pursuit of smaller gallinaceous birds, and that it is highly esteemed by the Chilian falconers. It very soon becomes quite docile, and will even follow its master within a few weeks of its capture.

I am indebted to my esteemed friend, Mr. Nathaniel H. Bishop, of Medford, Massachusetts, — a young and enthusiastic naturalist, whose zeal in the study of natural history prompted him, alone, unaided, and at the risk of his life, to explore the arid plains of South America, while yet a mere lad in years and stature, though his observations there exhibit the close and careful study of maturer years, — for two fine specimens of the eggs of this Hawk. They were obtained by him in the midst of the Pampas. The nest contained but these two, and was built on the top of a low bush or stunted tree, hardly two feet from the ground. It was constructed, with some pains and elaboration, of withered grasses and dry leaves.

The eggs in my possession measure, one $1\frac{13}{16}$ inches in length by $1\frac{11}{32}$ inches in breadth, the other $1\frac{25}{32}$ inches by $1\frac{3}{8}$. This does not materially vary from the measurement given by Darwin. The ground color of the egg is white. This, however, is so thickly and so generally studded with fine brown markings, that the white ground to the eye has a rusty appearance, and its real hue is hardly distinguishable. Over the entire surface of the egg is distributed an infinite number of fine dottings, of a color most nearly approaching a raw terra-sienna brown. Over this again are larger blotches, lines, and splashes of a handsome shade of Vandyke-brown. In the egg represented in the plate (Plate 3, fig. 22), these larger markings are much more frequent than in the other specimen, and produce quite a fine effect. The latter specimen is chiefly marked with the finer rusty dottings, but with only a few blotches of Vandyke-brown. It has, in consequence, a more dingy and less pleasing effect.

TINNUNCULUS SPARVERIUS.

Falco sparverius, Linn. Syst. Nat. I, 1766, 128.
" " Wils. Am. Orn. II, 1810, pl. xvi, fig. 1, and IV, pl. xxxii, fig. 2.
" " Bonap. Syn. 1828, p. 27.
" " Rich. & Swains. F. B. A. II, 1831, 31.
" " Nuttall, Manual, I, 1832, 58.
" " Aud. Orn. Biog. II, 1835, 246; V, 370, pl. cxlii.
" " " Syn. 1839, p. 17.
" " " Birds of Am. I, 1840, 90, pl. xxii.
" " De Kay, Nat. Hist. New York, I, 1844, 16, pl. vii, fig. 16.
Falco dominicensis, Gm. Syst. Nat. I, 1788, 285.
Cerchneis sparverius, Bonap. Geog. and Comp. List, 1838, p. 5.
Falco gracilis, Sw. Cab. Cyc. 1838, p. 281.
Falco cinnamominus, Sw. Cab. Cyc. 1838, p. 281.
Falco isabellinus, " " " " "
Tinnunculus sparverius, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 92.
" " " Zoölogy of U. S. Naval Astronomical Expedition, II, 1855, 176.

Vulg. — *The Sparrow-Hawk. Little Rusty-Crowned Falcon. Little Falcon. Emerillon de St. Domingue. Little Hawk. Emerillon de Cayenne.*

This species is one of the most widely distributed of North American birds, having been met with from latitude 50° north to the most extreme southern point of South America. Captain King found it at Point Famine in the Straits of Magellan. Sir John Richardson speaks of it as abundant on the banks of the Saskatchewan, in the neighborhood of the Carlton House. Darwin obtained it in Patagonia and Peru. Macleay, Lembeye, De Sagra, and Gundlach give it as a Cuban bird, the last of whom informs me that it breeds there. Mr. Pease obtained it in Mexico, Lieutenant Gilliss in Chile; Dr. Gambel found it abundant throughout California, as also did Mr. Audubon on the Yellowstone, in the Northwest Territory (now Nebraska). This Hawk probably breeds throughout North America, from Hudson's Bay to Mexico, and from Maine to California, though it is rare in the New England States. It constructs no nest, but makes use of hollow trees, the deserted hole of a woodpecker, or even an old crow's-nest. Its eggs are usually as many as five in number, and Mr. Audubon once even met with seven in a single nest. The ground of the eggs is usually a dark cream-color or a light buff. In their markings they vary considerably. Five from a nest in Maryland were covered throughout the entire surface with small blotches and dottings of a light brown, at times confluent, and, except in a single instance, not more frequent at the larger end than the smaller. Others, the contents of a nest obtained by Mr. Audubon in the Northwest Territory, had a ground color of a light buff, nearly unspotted, except at the larger end, with only a few large blotches and splashes of a deep chocolate. In others, interspersed with the light-brown markings are a few of a much deeper shade. In some, the eggs are covered with fine markings of buff, nearly uniform in size and color; and others again are marked with lines and bolder dashes of brown, of a distinctly reddish shade, over their entire surface, and often so thickly as nearly to con-

ceal the ground. The eggs are nearly spherical. Their average length is $1\frac{5}{16}$ inches by a breadth of $1\frac{2}{16}$. They are not subject to much variation either in size or shape.

Since the preceding pages were printed, I have received from an attentive correspondent, Mr. Archibald Hopkins, the son of President Hopkins of Williams College, the egg represented in Plate II, fig. 15 *a*. It was obtained in the neighborhood of Williamstown, Mass., and is interesting, both as showing that this Hawk, though rare in Massachusetts, does breed in certain parts of that State, and also on account of its well-defined markings, and the unusual depth and distinctness of their colors.

ACCIPITRINÆ.

ASTUR ATRICAPILLUS.

Falco atricapillus, Wilson, Am. Orn. VI, 1812, 80, pl. lii, fig. 3.
" " Nuttall, Manual, I, 1832, 85.
Astur atricapillus, Jardine & Selby, Illust. Orn. 1825, pl. cxxi.
" " Bonap. Geog. and Comp. List, 1838, p. 5.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 93.
Falco regalis, Temm. Pl. Col. 1827, tab. 495.
Falco palumbarius, Bonap. Syn. 1828, p. 28.
" " Aud. Orn. Biog. II, 1835, 241, pls. cxli and xxxvi.
Accipiter palumbarius, Rich. & Swains. F. B. A. II, 1831, 39.
Dædalion pictum, Less. Traité d'Orn. I, 1831, 67.
Astur palumbarius, Aud. Syn. 1839, p. 18.
" " " Birds of Am. I, 1840, 95, pl. xxiii.

Vulg. — *The Goshawk. American Goshawk. Ash-colored Hawk. Black-cap Hawk. Autour Royal.*

In regard to the distribution of the American Goshawk, much remains to be learned. It has nowhere been ascertained to be at any time common, and is only known to breed in the extreme northern parts of the United States. Dr. Gambel did not meet with it in California. The only known instance, at the time of my writing, of its occurrence near the Pacific coast, is that of a specimen in Dr. Suckley's collection, from the Columbia River,[1] and another from Steilacoom, Puget's Sound. It is chiefly found in the United States in winter. Sir John Richardson obtained a few specimens in the fur regions, and it appears to be not uncommon in New Brunswick, Nova Scotia,[2] Maine, Northern New York, Ohio, and even Pennsyl-

[1] Since the above was in type, I have learned from my friend, Mr. Cassin, that six specimens of the *Astur atricapillus* have been brought in the Government collections made by the Pacific Railroad Survey parties. These were collected by Dr. Suckley, in Washington Territory, or by Dr. J. G. Cooper, at Shoalwater Bay.

[2] While these sheets are passing through the press, Professor Baird has favored me with a list of the

vania. Our only knowledge of its nest is derived from Mr. Audubon, who observed these Hawks in the Great Pine Forest of Pennsylvania, and on the banks of the Niagara River, near the Falls.[1] He describes it as placed on the branches of a tree, and near the trunk. This nest was one of great size, and resembled that of a Crow in the manner of its construction, but was much flatter. It was made of withered twigs and coarse grass, with a lining of fibrous strips of plants resembling hemp. Another, found by Mr. Audubon, in the month of April, contained three eggs ready to be hatched. In another, the number was four. The only specimen of this egg that I have ever seen was one from Northern Ohio, near Cleveland. Its measurements are $2\frac{5}{16}$ by $1\frac{15}{16}$ inches. In its shape, it is nearly spherical; its surface is rough and granulated; its ground color is a soiled white with a hardly perceptible shade of bluish. It is marked irregularly with large but quite faint blotches of drab and yellowish-brown.

ACCIPITER FUSCUS.

Falco fuscus, Gmelin, Syst. Nat. I, 1788, 280.
" " Bonap. Syn. App. 1828, p. 433.
" " Aud. Orn. Biog. IV, 1838, 522, pl. cccl xxiv.
Falco dubius, Gmelin, Syst. Nat. I, 1788, 281.
Accipiter striatus, Vieill. Ois. Am. Sept. I, 1807, 42.
Falco velox, Wils. Am. Orn. V, 1812, 116.
" " Nuttall, Manual, I, 1832, 87.
" " Bonap. Syn. 1838, p. 29.
Falco pennsylvanicus, Wils. Am. Orn. VI, 1812, 13.
Sparvius lineatus, Vieill. Encyc. Meth. III, 1823, 1266.
Accipiter fringilloides, Vig. Zoöl. Jour. III, 1827, 434.
Accipiter pennsylvanicus, Rich. & Swain. F. B. A. II, 1831, 74.
Nisus malfini, Less. Traité, I, 1831, 58.
Accipiter fuscus, Bonap. Geog. and Comp. List, 1838, p. 5.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 95.
Astur fuscus, Aud. Syn. 1839, p. 18.
" " " Birds of Am. I, 1840, 100, pl. xxv.
" " Lembeye, Av. de la Isla de Cuba, 1850, p. 16.
Vulg. — *Sharp-shinned Hawk. Slate-colored Hawk. American Brown Hawk. Chicken Hawk. Autour à Bec Sincuse. Cernicalo Morado* (Cuba).

This species is one of the most common Hawks of North America, and its geographical range covers the entire continent, from Hudson's Bay to Mexico. Sir John Richardson mentions its having been met with as far to the north as latitude 51°.

birds of Nova Scotia, prepared by Lieutenant Bland of the Royal Engineers and Mr. John R. Willis of Halifax. In this catalogue, the *Astur atricapillus* is given as a bird of that Province, migratory and tolerably common.

[1] Birds of America, (8vo,) I, 97.

Drs. Gambel and Heermann both speak of it as abundant in California. Audubon found it very plentiful as far north as the southern shore of the Gulf of St. Lawrence. It has been obtained in New Mexico by Mr. McCall, in Mexico by Mr. Pease, and in Washington Territory by Dr. Cooper and Dr. Suckley. Both Dr. Gundlach and Lembeye give it as a Cuban species. It was not discovered in Jamaica by Mr. Gosse, nor am I aware that it has ever been detected south of Mexico. It has been ascertained, from my own observations as well as those of others, to breed in Massachusetts, New Jersey, Wisconsin, California, and Pennsylvania, and it probably does so in the intervening States and Territories, and indeed in all, except perhaps the most southern.

Neither Mr. Wilson nor Mr. Nuttall was so fortunate as ever to find the nest of this bird. Mr. Audubon speaks of having met with three, and all in different situations. One was in a hole in a rock, on the banks of the Ohio River; another was in the hollow of a broken branch, near Louisville, Ky., and the third in the forks of a low oak, near Henderson, Ky. In the first case, the nest was slight and simply constructed of a few sticks and some grasses, carelessly interwoven, and about two feet from the entrance of the hole. In the second instance there was no nest whatever; but in the third, the birds were engaged in the construction of an elaborate nest. The number of the eggs was four in one instance, and five in another. He describes them as almost equally rounded at both ends, though *somewhat elongated*, their ground color white, with a livid tinge, but scarcely discernible amid the numerous markings and blotches of reddish-chocolate with which they were irregularly covered. In a nest, which was large and elaborately constructed of sticks, and contained five eggs, found by Dr. H. R. Storer in Concord, Mass., there was a single egg which nearly corresponds with this description. It is, however, the only one among fifteen specimens which I have seen that at all agrees with it. This specimen is a little more than usually elongate, and its ground color, which is a purplish white, is nearly concealed by its blotches of various shades of sepia-brown. This egg is represented on Plate V, fig. 54. In every other instance, the egg is very nearly spherical, the ground color white, and beautifully marked with large confluent blotches of sepia, varying in depth from a quite light to a very dark shade. In one, these confluent markings form a broad belt around the centre of the egg. In others, they are chiefly distributed about one end. The contrast between the white ground and the dark confluent dashes of brown is very beautiful, and, except in size, the eggs of this bird bear a marked resemblance to those of the Sparrow-hawk of Europe. In a few instances, the brown markings have a purplish and reddish intermixture.

In a majority of the instances in which I have known of the existence of the nest of this Hawk, it has been constructed in trees. It is usually large in proportion to the size of the bird, and its materials are somewhat elaborately put together; it is composed chiefly of large sticks and twigs, and the whole platform is covered with a thin lining of dry leaves, mosses, grass, &c. Mr. John Krider of Philadelphia met with a nest in New Jersey, in the vicinity of that city, which was built on the edge of a high rock. Where such opportunities are afforded, this Hawk is often known to frequent similar situations; but its nest is more usually found in trees.

The eggs represented on Plate III, figs. 23 and 24, are the more common varieties. Figs. 23 and 54 (Plate V) were from the same nest, and obtained by Dr. H. R. Storer in Concord, Mass. The egg copied in fig. 24 was obtained in New Jersey by Mr. John Krider, of Philadelphia.

ACCIPITER COOPERII.

Falco cooperii, Bonap. Syn. 1828, App. p. 433.
" " " Am. Orn. II, 1828, p. 1.
Astur cooperii, Bonap. Geog. and Comp. List, 1838, p. 5.
" " Aud. Syn. 1839, p. 18.
" " " Birds of Am. I, 1840, 98, pl. xxiv.
" " Lembeye, Av. de la Isla de Cuba, 1850, p. 17.
Falco stanleyii, Aud. Orn. Biog. I, 1834, 186, pl. xxxvi.
" " " " " II, 1835, 245, pl. cxli.
Accipiter cooperii, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 96.
Vulg. — *Cooper's Hawk. Stanley Hawk. Hen-Hawk. Azor Americano* (Cuba).

Cooper's Hawk is quite common throughout the United States, but probably does not extend its migrations much, if at all, beyond the limits of the Union. It is especially abundant in the Middle States, and particularly so along the banks of the Potomac River. I have received reliable information of its breeding in Vermont, Massachusetts, Ohio, Maryland, Virginia, and South Carolina. It undoubtedly nests in all the intervening States. Lembeye and Dr. Gundlach give it as a resident of Cuba, and although it has not yet been ascertained to rear its young in that island, such is probably the case. Mr. Gosse did not meet with the Cooper's Hawk in Jamaica. Drs. Gambel and Heermann found it very abundant throughout California. Lieutenant Trowbridge obtained several near San Francisco, and Dr. Cooper others in Washington Territory.[1]

My specimens of its eggs from South Carolina were obtained by Messrs. A. D.[2] and M. A. Curtis, Jr., the sons of Rev. M. A. Curtis, of Society Hill, in that State. Mr. Curtis, Sen. has kindly furnished me with the following description of its nest: — "The nest of the Cooper's Hawk was built in the triple fork of a tall black gum (*Nyssa multiflora*), near the top of the tree, which stood in a swamp. The nest was formed of a layer of small sticks, $\frac{1}{3}$ to $\frac{1}{2}$ inch in diameter. Its external diameter varied from $1\frac{1}{2}$ to 2 feet. This layer was $\frac{7}{8}$ inch in thickness, with only

[1] More recent investigations show this Hawk to be abundant in Texas and New Mexico. The Government Survey parties have obtained numerous specimens in both regions.

[2] Since the above was prepared for the press, Mr. A. D. Curtis, to whose kindness I am chiefly indebted for a certain identification of the egg of this Hawk, has been taken from the field in which he had already given so much promise of future distinction, by an early death. The writer cannot omit the occasion to pay the passing tribute of his regard for that which Mr. Curtis had, thus young, contributed to the cause of scientific research, and of his regret for the loss of the rich promise the future seemed to hold out, from his interest, zeal, and intelligent investigation in natural science.

a slight depression in the centre, hardly enough to keep the eggs from rolling out. A few thin pieces of pine bark formed the bed for the eggs."

Another nest, obtained in Randolph, Vt. by Charles S. Paine, Esq., is thus described by him in a letter: — "The nest was built of hemlock twigs, and lined with small, thin pieces of hemlock bark, such as hang loosely on the tree. The Hawk, when the nest was approached, did not whistle, as some others of that family do, but uttered a cry of Ge! ge! ge! ge! This was repeated several times with great rapidity, by both male and female."

The average size of the eggs of this bird is $1\frac{15}{16}$ by $1\frac{9}{16}$ inches. The color is usually a uniform dull white, but occasionally tinged with a slight bluish shade. They are nearly spherical, though less so than the eggs of several species, and are equal at either end. Their surface is slightly granulated. The number of the eggs varies from three to four, though occasionally there are five in a nest. The egg figured is from South Carolina, and from the nest above mentioned.

BUTEONINÆ.

BUTEO BOREALIS.

Falco borealis, Gmelin, Syst. Nat. I, 1788, p. 266.
" " Wils. Am. Orn. VI, 1808, pl. lii, fig. 1.
" " Rich. & Swains. F. B. A. II, 1831, 50.
" " Aud. Orn. Biog. I, 1832, 265; V, 378, pl. li.
" " Nuttall, Manual, I, 1832, 102.
Falco leverianus, Gmelin, Syst. Nat. I, 1788, 266.
" " Wils. Am. Orn. Biog. VI, 1812, 78, pl. lii, fig. 2.
Falco jamaicensis, Gmelin, Syst. Nat. I, 1788, 266.
Falco aquilinus, Bartram, Trav. 1791, p. 290.
Buteo ferruginicaudus, Vieill. Ois. d'Am. Sept. I, 1807, 32.
Accipiter ruficaudus, " " " " " 47.
Buteo fulvus, Vieill. Nouv. Dict. 1816, IV, 472.
Buteo americanus, Vieill. Nouv. Dict. 1816, IV, 477.
Buteo borealis, Bonap. Geog. and Comp. List, 1838, p. 3.
" " Aud. Syn. 1839, p. 6.
" " " Birds of Am. I, 1840, 32, pl. vii.
" " Gosse, Birds of Jamaica, 1847, p. 11.
" " Lembeye, Av. de la Isla de Cuba, 1850, p. 18.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 97.

Vulg. — *The Red-tailed Hawk. Red-tailed Buzzard. American Buzzard. White-breasted Hawk. Great Eagle Hawk. The Hen-Hawk. Gavilan Coli-rojo* (Cuba).

The Red-tailed Hawk of the Atlantic States is another of the Raptorial family that appears to be very widely distributed throughout the North American continent. According to Richardson, it is rather common in the fur countries, which it

visits in summer, and where also it occasionally breeds. Mr. Gosse states that it is the most common bird of this family in Jamaica, of which island it is a resident, and where, though he never met with its nest himself, he was assured by others that it does breed.[1] Mr. Lembeye and Dr. Gundlach both include it in their lists of the birds of Cuba, and the latter also marks it as breeding in that island. It has been observed in Florida, Mississippi, Ohio, and Wisconsin, and is not uncommon in all the New England States, where it is resident throughout the year. In the Southern States it is most abundant in the winter months.

Some doubts have prevailed whether this, or a distinct but closely identical species, is found on the Pacific coast, and it now seems quite probable that the *Buteo borealis* is not found there.[2] A species quite abundant in California has, until recently, been supposed to be the *Buteo swainsoni*. Mr. Cassin, Dr. Heermann, Dr. Gambel, Dr. Trudeau, and others, have taken this Western variety to be that species. The examination of three undoubted specimens of the veritable *B. swainsoni* first induced Mr. Cassin to revise his views in respect to the Western varieties, and for a while to regard them as exhibiting no differences but such as are consistent with a specific identity with the *borealis*. To this opinion I was not quite able to subscribe. The eggs of the Western birds had been described to me as exhibiting such constant and well-marked variations from those of the common Red-tail, that I could not believe them to belong to the same bird.

Soon after the publication of Mr. Cassin's valuable paper upon the Falconidæ of North America,[3] I expressed to him, in view of the constant difference between the eggs of the Eastern and Western varieties, a belief that, if the eggs from the West were those of a Red-tailed Hawk, the latter would be found to be a distinct, however closely allied, species, and not our Eastern Red-tailed Hawk. These anticipations have been fully confirmed. Mr. Cassin has since satisfactorily ascertained the existence of a constancy of different characters,[4] which readily distinguish the Western bird from the well-known species of the Atlantic coast, besides the peculiarities of their voice and the difference of their eggs, all of which appear to be sufficiently well marked to establish the two varieties as specifically distinct. These differences were first noticed by Messrs. Nuttall and Townsend, the former of whom described the Western bird as a distinct species.[5]

[1] "A young friend informs me that he lately knew of the nest of this Hawk, a large mass near the top of an immense cotton-tree, into which he observed the old birds frequently go. It was at Content, in the parish of St. Elizabeth. The gigantic dimensions of the tree rendered its summit perfectly inaccessible, and prevented particular examination." (Gosse's Birds of Jamaica, p. 14.)

[2] As it now appears to be a well-ascertained fact that the common variety of California is a different bird from the Red-tailed Hawk of the Atlantic States, it becomes a matter of much interest to define the limits of the two species, and to ascertain to what extent, if any, they frequent common grounds. There is at present no reason for doubting the identity of the West-Indian bird with that of the Atlantic States.

[3] Proceedings of Philadelphia Academy, February, 1855, p. 279. Cassin's Notes on North American Falconidæ.

[4] Proceedings of Philadelphia Academy, February, 1856, p. 39.

[5] Nuttall's Manual, I, 1840, 112.

The *Buteo borealis* constructs a large nest, composed externally of coarse sticks and twigs, and lined with dried grasses, moss, and leaves, built for the most part in the fork of a lofty tree. The eggs are usually four in number.

The egg represented in Plate II, fig. 16, was obtained near Salem, Mass. It was fully identified, the parent bird having been shot from her nest. It varies somewhat in its shape from any of the eggs of this Hawk that I have yet met with, being pyriform, and one end much more pointed than the other. It measures $2\frac{3}{16}$ inches in length by $1\frac{11}{16}$ in breadth. Its ground color is a yellowish white, which is partially intermixed with, rather than covered by, a large number of purplish spots and blotches. These faint purplish markings are found in all of the eggs of this Hawk that I have seen, but in this one are more than usually frequent. Over these prevail irregular collections of blotches and markings, of unequal size, of a light shade of Dutch umber. This egg was presented me, several years since, by the Salem Natural History Society, now known as the Essex Institute.

That given in Plate II, fig. 17, is a larger egg, measuring $2\frac{4}{16}$ inches in length by $1\frac{25}{32}$ in breadth. It also varies in the color of its secondary markings from any Red-tailed Hawk's egg that I have seen. Its ground color is a yellowish white, intermixed here and there, but sparingly, with obscure markings of a dull purplish. Over the entire surface of the egg is diffused a light tone of brown, most nearly approaching a burnt umber. If examined with a powerful magnifying-glass, this color appears to be distributed in small granulations, prevailing over the whole egg, but predominating at the smaller end, and only there assuming anything of the character of blotches or confluent spots. This egg is almost an exact ovoid, and one end is only slightly smaller than the other. It was taken in Bethel, Vermont, from a nest which contained three young birds. When received in Boston, the chick was alive in the egg, and upon an opening being made in the shell, several days after it was taken, the young Hawk was quite lively, made repeatedly an audible noise, and lived half an hour after its premature and unnatural delivery.

An egg obtained in Danvers, Mass., by Augustus Fowler, Esq.,[1] an accurate and observing ornithologist, is represented in Plate II, fig. 17 *a*. It is almost spheroidal in its shape, and neither end is perceptibly smaller than the other. It measures

[1] The following observations in regard to the habits of this Hawk, as noticed by Mr. Fowler, are extracted from a letter by that gentleman, dated Danvers-Port, December 25, 1856: —

"This species of Hawk (*Buteo borealis*) usually begin to build their nests about the first of April. They select some tall tree near the middle of the woods, the branches of which form a crotch near its trunk. To this chosen spot the female carries a sufficient quantity of sticks for its outside, (the male taking no very active part in the matter,) and for its inside she uses the bark from the dead branches of the chestnut, which she beats and pecks to pieces with her bill, making it soft and pliable, or gathers the fallen leaves of the pine, or some other soft material, which she finds conveniently, as a lining, which is about one inch in thickness; it is 13 inches in diameter from outside to outside, and 7 inches in diameter on the inside, while its depth is $2\frac{1}{2}$ inches. The female usually lays five eggs, which are spherical, of a dirty-white color, and marked with large blotches of brown; on some they cover almost the whole egg, while others are marked mostly on the large end, and some even of the same litter are so faintly marked as to appear almost wholly white. They are $2\frac{1}{3}$ inches in length, and $1\frac{3}{4}$ inches in diameter."

$2\frac{2}{16}$ inches in length by $1\frac{12}{16}$ in breadth. Its ground color is a dull white, intermixed with which are frequent small markings of dull purplish. Over these are numerous large confluent blotches of a brown, of a light tone, and almost exactly conforming with the tint known as Dutch umber. These are chiefly diffused around one end of the egg, covering about one half of it with a large ring of close and confluent markings. Over the rest of the egg these markings are distributed in smaller spots and dottings, of the same shade of color.

Another egg from the same nest corresponds exactly in size and shape with the preceding, but varies greatly in its general appearance, in consequence of the almost total absence of the Dutch-umber markings. These are few and small, and are nearly all confined to a small portion of one end of the egg. The ground color is also a dull white, and the markings of dull purplish which are intermixed with it are larger, more frequent, and, in consequence of the absence of the brown, much more conspicuous and noticeable.

Another egg of this Hawk, obtained in Danvers by Mr. S. P. Fowler, a brother of the gentleman just referred to, again varies perceptibly in its markings. It measures $2\frac{1}{16}$ inches in length by $1\frac{11}{16}$ in breadth. Its ground color is a dirty white, very closely intermixed with frequent minute markings of a dull purplish, which give a dingy effect to the ground. It is blotched and marked, chiefly at the larger end, with bold, distinct, and not confluent spots, of a greenish umber, intermixed with darker spots of Vandyke-brown. One end of the egg is slightly larger than the other.

Another egg, of which I have only a drawing, is very nearly spherical. Its measurements are $2\frac{2}{16}$ by $1\frac{13}{16}$ inches, and its markings are numerous confluent blotches of dark slaty-brown and light umber, upon a clay-colored ground.

BUTEO SWAINSONI.

Buteo vulgaris, Rich. & Swain. F. B. A. II, 1831, 47.
Buteo swainsoni, Bonap. Geog. and Comp. List, 1838, p. 3.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 98.
" " " Proceedings Phil. Acad. Feb. 1855, p. 280.
Falco buteo? Aud. Orn. Biog. IV, 1838, 508, pl. ccclxxii.
Buteo vulgaris? Aud. Syn. 1839, p. 5.
" " " Birds of Am. I, 1840, 30, pl. vi.
Vulg. — *Swainson's Buzzard. The Western Buzzard. The Common Buzzard. The Northern Buzzard.*

An egg, of which I possess only a copy, and which I am unable to represent in the plate, was obtained in the northern part of California, by Dr. Heermann. It was kindly lent me for inspection. At the time it was obtained, it was supposed to be well identified as the egg of this Buzzard, and but for the confusion which has since

been found to have prevailed among our ornithologists in regard to the lines of separation between this and two other North American Hawks, elsewhere referred to more at length, there would be no doubt, in my mind, that this paternity was unquestionable. As it is, I am of the opinion that it is probably rightly named. I take only the precaution of stating that it is barely possible Dr. Heermann may have mistaken a different hawk for a *B. swainsoni*, and that it may be found to belong to another bird. This egg differs materially from those of *B. montanus*, is more pointed at the smaller end, and is of a somewhat less capacity. The ground color is a bluish-white, and the egg is marked at one end with blotches and spottings of a light sepia-brown. Its measurements are $2\frac{3}{16}$ inches in length, by $1\frac{12}{16}$ in breadth. According to Sir John Richardson (*Fauna Boreali Americana*, II, 4), the *B. swainsoni* arrives in the fur countries in the middle of April, and soon afterwards begins to build its nest on a tree, of short sticks, lining it sparingly with deer's hair. The eggs, from three to five in number, are equal in size to those of the domestic fowl, and have a greenish-white color, with a few large dark-brown blotches at the thick end. The one described above was spotted at the smaller end, an accidental but by no means uncommon occurrence in the eggs of many species.

The geographical distribution of this Hawk can as yet hardly be regarded as having been well determined. Thus far the only specimens brought home by recent collectors have been from the region between the Yellowstone River and the Great Salt Lake, and southward, along the eastern slope of the Rocky Mountains, to the Staked Plains of Texas. None have been found thus far on the Pacific coast, or east of the Mississippi River. Dr. Heermann's specimen, if really the present species, will extend this range to the westward.

The egg represented in the plate was taken by Dr. James Trudeau near Saline, Arkansas, who assured me that he identified it with its parent. It differs from Dr. Heermann's specimen in size, and in the absence of distinct spottings. It varies also from the descriptions given of the egg by Richardson and Swainson.

I have also a drawing of an egg taken by Dr. Trudeau in Western Louisiana, and supposed by him to be an egg of this Hawk. They present no unusual variations, the principal being in the depth of the secondary coloring. They are each of an extremely well marked oval shape, approaching a spheroidal. The Arkansas egg measures $2\frac{5}{16}$ inches in length by $1\frac{14}{16}$ inches in breadth. The measurement of that from Louisiana is $2\frac{6}{16}$ inches by $1\frac{13}{16}$, being a little more oblong and less spheroidal. The ground color of both is white, and each is sparingly spotted and blotched with markings of light umber-brown and a purplish-slate. In the specimen from Saline, these markings are fainter, and the shades of color less distinctly traced.

Since the above was prepared for publication, I have received from Mr. Krider of Philadelphia an egg of the *B. swainsoni*, which I have substituted in the plate for the egg given me by Dr. Trudeau, and mentioned above. It was obtained by Dr. Heermann, in California, and by his permission was forwarded at the last moment in which it could be made available for the present work. Its size is almost exactly that of the one from Saline; its shape and general appearance are the same, except that it is more distinctly marked with secondary colors. This egg may be

described as $2\frac{5}{16}$ inches in length by $1\frac{27}{32}$ in breadth; its ground is a yellowish-white or cream-color; sub-markings of a purplish-gray occur; over the entire egg, in scattered, irregular patches, are spots and blotches of a very light tone of umber-brown, but these are nowhere confluent or frequent in number. Traces of these markings exist in the Arkansas specimen, but so faintly, that they would, unless looked for carefully, be mistaken for accidental discolorations. In regard to its exact locality, or the circumstances attending its discovery, I am unable at present to add anything.

BUTEO MONTANUS.

Falco buteo, Aud. Orn. Biog. IV, 1838, 508, pl. ccclxxii.
Buteo vulgaris ? Aud. Syn. 1839, p. 5.
" " " Birds of America, I, 1840, 30, pl. vi ?
Buteo montana, Nuttall, Manual, I, 1840, 112.
Buteo swainsoni, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 98.
Buteo borealis, Cassin, Notes on N. A. Falconidæ, — Proc. Phil. Acad. Feb. 1855, p. 279.
Buteo montanus, Cassin, Proc. Phil. Acad. Feb. 1856, p. 39.
Vulg. — *The Western Buzzard. The Western Red-tailed Hawk. White-throated Buzzard.*

Three separate species of North American Hawks, having a more or less close resemblance, have been confounded one with the other. At least their specific distinctness has not until very recently been well ascertained. These, as has been already stated, are the common Red-tailed Hawk (*Buteo borealis*) of the Atlantic States, Swainson's Buzzard (*Buteo swainsoni*, Bonap.), and the Western Red-tailed Hawk (*Buteo montanus*). The last named has only recently had its claims to be received as a distinct species duly recognized. The obscurity which has rested over these claims of the Western Red-tail to be regarded as specifically distinct, has at last yielded to the results of Mr. Cassin's diligent investigations; and the uncertainties which have hitherto prevailed may now be considered as having been entirely removed by the satisfactory paper of that naturalist. A brief review of the history of these gradual steps towards our present knowledge may not be inappropriate in this connection.

The common Red-tailed Hawk of the Atlantic States was known to the earliest American naturalists. Its distinguishing characters have always been regarded as well defined, and the species has been well known to all American ornithologists. The bird now received as a good species, under the name of Swainson's Buzzard, was first described in Richardson and Swainson's *Fauna Boreali-Americana*, as identical with the Common Buzzard (*Buteo vulgaris*) of Europe.[1] It is there spoken of as quite a common bird in the fur countries. This species was first claimed

[1] In the same work, Mr. Swainson described, as the female of this species, a bird which is not identical with it, but is probably a female *B. montanus* in an immature plumage.

as new, and a distinct one from the *B. vulgaris*, by Bonaparte (Geog. and Comp. List, p. 3), who named it *Buteo swainsoni*, in honor of Mr. Swainson, who was the first to describe it. The third species, *Buteo montanus*, or Western Red-tail, was first given as a distinct bird by Mr. Nuttall; but its claims to this distinction have remained unrecognized until very recently. Mr. Audubon, in each of his several works, has regarded Swainson's Buzzard as identical with the European, and has even added to the prevailing confusion, by figuring, in his representation of it, the young of a different species, probably *B. montanus*. Subsequently, Mr. Cassin, in the carefully prepared Synopsis accompanying his Illustrations of the Birds of California and Texas, classed both the Western varieties under the single name of *Buteo swainsoni*. Afterwards, in his paper on the *Falconidæ* of North America, published in the Proceedings of the Philadelphia Academy of Natural Sciences, February, 1855, Mr. Cassin recognized *B. swainsoni* by its true specific characters, having then for the first time seen three undoubted specimens of that bird in the collection made by Mr. Kreutzfeldt, of Lieutenant Beckwith's party. Referring to *Buteo borealis*, in the same paper, he did not regard it as specifically distinct from the Western variety. He says: —

"In the comparison of numerous specimens of adults and young, from various localities in Western North America, with others obtained in the vicinity of Philadelphia, I have failed to detect any differences not consistent with specific identity. There is in some specimens a greater extent of the brown color on the breast, and a deeper shade of rufous on the abdomen and tibiæ, than are usual in Eastern specimens; but I have found no character in the Western bird that I have not seen at some time in the other."

Mr. Cassin's attention having been called to the fact that the eggs of the Eastern and Western species present constant and well-marked differences, in another paper, published in the Proceedings of the Philadelphia Academy of Natural Sciences, February, 1856, he referred the Western variety to Mr. Nuttall's *Buteo montanus*, as given in the 1840 edition of his Manual of the Ornithology of the United States. In this last paper he says: —

"On examination of not less than twenty specimens of this bird, from various localities in the Western countries of North America, I have found the characters constantly present which distinguish it from the *Buteo borealis*, as pointed out in my Birds of California and Texas, p. 98. The voice of this species is represented by several of the late naturalists who have visited California as quite peculiar, and I am assured by my friend, Dr. Thomas M. Brewer, of Boston, that the egg is entirely different from that of *B. borealis*. Though nearly related to that species, it is very probably entitled to be regarded as distinct, for which purpose Mr. Nuttall's name, as above given, is proper."

In regard to the range of the bird, we have yet to learn with certainty the extent of its general distribution. It appears to be of very common occurrence in and about California, being brought in nearly every collection from that part of the country. It also occurs among the birds obtained by Drs. Suckley and Cooper in Washington Territory. Dr. Townsend procured several specimens in the Rocky Mountains.

It is probable that it is distributed throughout the greater part of North America west of the Mississippi, and we may yet hear of stray individuals on the eastern side of that river.

Two eggs belonging to a bird of this species were obtained by Mr. Samuels near Petaluma, California, in 1856, one of which is represented in Plate I, fig. 6. This egg measures $2\frac{5}{16}$ inches in length, by $1\frac{14}{16}$ inches in its greatest breadth. The shape of the egg is an almost exact ovoid, slightly tending to a spheroid, one end being hardly perceptibly larger than the other. Its ground color is a very light buff, the spottings and markings giving to it the effect of a yellowish-white. The egg is marked over the entire surface with blotches, dashes, and lines of a light tint of a brown tending to Vandyke. These are mixed with markings of a lighter purplish-brown. The markings, of both shades, are chiefly oblong in shape, and run with the length of the egg. They bear no resemblance to any eggs of the *B. borealis* that I have ever seen, and are also quite unlike those of any other Hawk, so far as I am aware.

The nest was discovered by Mr. Samuels, not far from Petaluma, California, close to the Mission House, near Petaluma Flat. It was built on the top of a large evergreen oak, at least seventy feet from the ground, and was constructed entirely of large, coarse sticks, lined with a few stray feathers. The eggs were two in number, and had been set upon a short time. The male bird was shot as it flew from the nest, which was so hidden by the thick branches that it would have escaped detection.

BUTEO LINEATUS.

Falco lineatus, Gmelin, Syst. Nat. I, 1788, 268.
" " Wils. Am. Orn. VI, 1812, 86, pl. liii, fig. 3.
" " Aud. Orn. Biog. I, 1832, 296; V, 380, pls. lvi and lxxi.
" " De Kay, Nat. Hist. New York, 1844, pl. vi, fig. 13.
Falco hyemalis, Gmelin, Syst. Nat. I, 1788, 268.
" " Wils. Am. Orn. IV, 1812, 73.
" " Bonap. Syn. 1828, p. 33.
" " Nuttall, Manual, I, 1832, 106.
" " Aud. Orn. Biog. I, 1832, 364.
Falco buteoides, Nuttall, Manual, I, 1832, 100.
Buteo hyemalis, Bonap. Geog. and Comp. List, 1838, p. 3.
Buteo lineatus, Aud. Syn. 1839, p. 7.
" " " Birds of America, I, 1840, 40, pl. ix.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 99.
Vulg. — *The Red-shouldered Hawk. The Winter Hawk. Winter Falcon. Hen-Hawk. Chicken-Hawk.*

The northern limits of this common species have not been well ascertained. In some cases they have been incorrectly stated.[1] Mr. Nuttall supposed it to be re-

[1] Mr. Audubon was, in his first issues, disposed to make two distinct species, based upon the mature

stricted to the Middle States, and says that it is never found in Massachusetts. This is quite a mistake. It is not only not uncommon in that State, but has been ascertained to breed there, and is also found abundantly throughout the year. It also undoubtedly breeds still farther to the north, as young birds visit the vicinity of Boston at certain seasons, evidently from a more northern quarter. According to the late Rev. Zadock Thompson, of Burlington, whose authority is unquestionable, it breeds throughout Vermont. It is therefore quite probable that this Hawk may be found in every part of the United States,[1] except where it is replaced by the Western variety, *Buteo elegans*. It has been observed in Oregon. Dr. Gambel speaks of it as "common," and Dr. Heermann as "abundant," in California; but it is quite probable they referred to a bird now considered a distinct species. It breeds abundantly throughout South Carolina, where, I am assured by Rev. Dr. Bachman, of Charleston, it is much the most common Hawk, and it is equally frequent throughout Florida. It is not given by Dr. Gundlach as a bird of Cuba, nor by Mr. Gosse as a bird of Jamaica. It was not met with by Sir John Richardson in the Arctic regions. Vermont and Oregon, or about latitude 45°, appear to be the most northern limits to which it has been positively traced.[2]

This Hawk constructs a large nest, resembling that of the Crow, in the forked branches of a high tree. It is composed externally of sticks, and is lined with moss and soft leaves. The eggs are four in number, occasionally three or two. When the nest is approached, the bird utters loud, frequent, and peculiar cries of alarm and resentment, not unlike Keé-oó! rapidly repeated, but makes no attempt at resistance. They will return year after year to the same nest, even when it has been robbed the previous season.

The eggs of this bird vary remarkably in size and ground color, and also in the frequency of the secondary markings. In the shape of the eggs and the color of the markings there is no essential variation that I am aware of. Their difference in length is sometimes as great as one fifth of an inch, and in breadth one sixth of an inch. I have in my possession the copy of a drawing by Mr. Audubon, of what must be a not very common variety; at least I have never met with the light blue of the ground there represented, and which is also spoken of by Mr. Thompson, in his

and the immature plumage of this bird. He even went so far as to assign to these supposed distinct species very different habits, cries, and geographical distribution. The mature bird (*lineatus*) is represented as a Southern species, stopped by the Middle States; the immature (*hyemalis*), as a Northern bird, visiting the United States only in winter. Even in his later work, in which he recognizes their identity, he persists in still assigning them certain imaginary diversities. Sir William Jardine, in some notes to his edition of Wilson's Ornithology, goes a step farther in error, and makes these imaginary differences of habit not only specific, but generic, allying the *hyemalis* with the Harriers (*Circi*), and the *lineatus* with the *Asturs!*

[1] Mr. Cassin (Proceedings of Philadelphia Academy, Feb. 1855, p. 281) describes as a distinct species *B. elegans*, the variety which has probably been taken, on the Western coast, for the Red-shouldered Hawk of the Eastern States.

[2] Since the above was written, I have seen a list of the birds of Nova Scotia, prepared by Lieutenant Bland (Royal Engineers), in which I am not surprised to find *Buteo lineatus* marked as a common and migratory species in that Province.

descriptions of the birds of Vermont.[1] Two eggs from New Jersey, measuring $2\frac{1}{1\,6}$ inches in length, by $1\frac{1}{1\,6}$ in breadth, have a brownish-white ground, marked with large blotches of yellowish umber, chiefly around the larger end, where they form a confluent ring. One of these is represented in Plate III, fig. 25. Two others, from a nest in Massachusetts, exhibit the following measurements: $2\frac{3}{1\,6}$ by $1\frac{1}{1\,6}$, and $2\frac{2}{1\,6}$ by $1\frac{1}{1\,6}$ inches. One of these has a dirty-white ground, with large, irregular blotches of umber and sienna brown, mingled confusedly together, of different shades, and nearly covering the whole surface. The other is nearly unspotted, has the lighter brown markings of the preceding, which are not well defined, and are diffused over about one half of its surface. The ground color is more distinctly white, but with no bluish shade. Two others belonging to this species, obtained in Milton, Mass. by Mr. E. Samuels, and identified by securing the parent bird, may be thus described. One measures $2\frac{1}{1\,6}$ by $1\frac{1}{1\,6}$ inches; the ground color is a dirty white, and is marked with large blotches, lines, and dottings of umber-brown, of various shades, from quite dark to light. The other is 2 inches by $1\frac{1}{1\,6}$, has a bluish-white ground, and is only marked by a number of very faint blotches of yellowish-brown and a slate-drab. Except in their shape, which is an oval spheroid, slightly pointed at one end, these bear but very slight resemblance to each other, though taken at the same time from one nest. Two more from Cheraw, S. C., also found in one nest, vary even more than these. One is 2 by $1\frac{9}{1\,6}$ inches; the ground color is a dull, soiled white, marked chiefly at the larger end with bold, distinct blotches of deep umber-brown. The other measures $2\frac{1}{1\,6}$ by $1\frac{9}{1\,6}$ inches; the ground color is a light slate-drab, with hardly any markings, except some ill-defined blotches of the same color as the ground, but of a deeper shade. There is also a slight variation in their shape, the latter being more oblong.

[1] History of Vermont, Natural, Civil, and Statistical, by Zadock Thompson, (Burlington (Vt.), 1842,) p. 60.

BUTEO PENNSYLVANICUS.

Falco latissimus, Wils. Am. Orn. VI, 1812, 92.
Falco pennsylvanicus, Wils. Am. Orn. VI, 1812, 92, earlier copies.
" " Bonap. Syn. 1828, p. 29.
" " Nuttall, Manual, I, 1832, 105.
" " Aud. Orn. Biog. I, 1832, 461; V, 377, pl. xci.
" " De Kay, Nat. Hist. New York, 1844, pl. v, fig. 2.
Sparvius platypterus, Vieill. Encyc. Meth. III, 1823, 1273.
Falco wilsonii, Bonap. Jour. Acad. Phila. III, 1824, 348.
Buteo pennsylvanicus, Bonap. Geog. and Comp. List, 1838, p. 3.
" " Aud. Synopsis, 1839, p. 6.
" " " Birds of Am. I, 1840, 43, pl. x.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 100.
Buteo latissimus, Lembeye, Av. de la Isla de Cuba, 1850, p. 19.
Vulg. — *The Broad-winged Hawk. Falcon de Monte* (Cuba).

This bird appears to be nowhere a very common species, with perhaps the exception of the peninsula of Florida, and not to have a very extended range. It has not been found in the fur regions, nor, so far as I am aware, upon any portion of the Pacific coast, nor yet in New Mexico, Texas, or Mexico. In Cuba, Dr. Gundlach informs me, it is a resident species, and breeds in the island, which Mr. Lembeye also confirms. Yet Mr. Gosse did not observe it in Jamaica, nor do I know that it has been obtained either in Central or South America. It is occasionally found in Massachusetts, where it undoubtedly breeds.[1] The late Professor Adams of Amherst met with it nesting near Middlebury, Vermont, some years since. It therefore probably occurs throughout New England, and, it is quite possible, in all the Atlantic States also. Dr. Hay mentions it as common in Wisconsin, but this does not correspond with the information I have from other naturalists in that State. Mr. Audubon speaks of this Hawk as rare in Louisiana, and as only occasionally found in that State in severe winters; but as by no means rare in Virginia, Maryland, and the States eastward. Nests of this species have been observed in Vermont, New Jersey, Pennsylvania, and Florida. Beyond these data I have no certain information in regard to its distribution.

The nest found by Mr. Audubon was about the size of that of the Crow, and was placed in the larger branches of a tree, near the trunk. It was composed externally of dry sticks and briers; internally, of small roots, and lined with numerous large feathers. The nest found by Professor Adams, now in the museum of Middlebury College, Vermont, was quite large, when we consider the size of the Hawk, and was coarsely constructed of sticks, and lined only with fibrous roots and fine grass. In this instance the eggs were three. This, I am inclined to believe, is the more usual number; Mr. Audubon, however, gives it as four or five.

[1] Since the above was in type, I have seen an egg belonging to Mr. Archibald Hopkins, and obtained in Williamstown, Mass., which is undoubtedly one of this species.

Three eggs in my cabinet, from Pennsylvania, Vermont, and New Jersey, exhibit the following measurements: $2\frac{1}{16}$ by $1\frac{9}{16}$; $1\frac{15}{16}$ by $1\frac{8}{16}$; and $1\frac{14}{16}$ by $1\frac{8}{16}$ inches. In the first of these, the ground color is a grayish or dirty white, with a slightly silvery shade, and is nearly covered by large and irregular markings of faint purplish-brown, and dull shadings of a lighter brown. The specimen described was given me by Dr. James Trudeau as undoubted. In both the others, the ground color is distinctly white, and they are marked over the entire surface with irregular clusters of blotches of a light reddish-brown, intermixed with a few dottings and lines of a deeper shade of brown, which at times almost deepen into a black.

The eggs represented in the plate are from New Jersey, Pennsylvania, and Florida. For the first of these (Plate I, fig. 8) I am indebted to Mr. John Krider, of Philadelphia, who has several times met with nests of this Hawk in New Jersey, not far from Philadelphia. The second (Plate I, fig. 9) was given me by Dr. Trudeau, who obtained it in Pennsylvania. The third (Plate 1, fig. 10) was obtained by one of the recent Government expeditions in Florida, where this bird seems to be more common than in any other part of the United States.

BUTEO CALURUS.

Buteo calurus, Cassin, Proc. Phil. Acad. Feb. 1855, p. 277.
Vulg. — *Black Hawk. Black Red-tail.*

The egg represented (Plate I, fig. 7) was obtained in California, by Mr. Emanuel Samuels, while engaged in making collections in natural history for the Boston Society of Natural History and the Smithsonian Institution. It was fortunately well identified with its parent, the male bird having been shot on its nest.

This Hawk is comparatively a new species, having been met with for the first time by T. Charlton Henry, M.D., U. S. Army, in the vicinity of Fort Webster, New Mexico, and described by Mr. Cassin in the Proceedings of the Academy of Natural Sciences, Philadelphia, February, 1855, p. 277. The specimen obtained by Mr. Samuels, with the egg, is the second that has been discovered at the present time, so far as I am aware. In regard to its habits and specific peculiarities but little is known, and its geographical distribution can only be conjectured from the two points, about a thousand miles apart, where the two representatives of this species were obtained,— Fort Webster and Petaluma.

The nest was found by Mr. Samuels on a hill north of Petaluma, California. It was built near the top of an evergreen oak, at the height of about sixty feet from the ground. The nest contained two eggs at the time it was discovered, which were just on the point of hatching. It was constructed of sticks, and was lined with moss. Both birds were about the spot. The male bird, manifesting much more

courage than his mate in resistance to the intruders, was shot. The female was wounded, but escaped.

The egg of the *B. calurus* measures $2\frac{4}{16}$ inches in length by $1\frac{3}{16}$ in breadth. Its capacity is considerably less than that of the *B. montanus;* its shape is a much more oblong oval; one end is evidently more pointed than the other. Its ground color is a dirty cream-white. It is covered, chiefly at the larger end, with blotches and smaller markings of a dark shade of a brown almost exactly corresponding with that known as Vandyke-brown, with smaller markings and spottings of a lighter shade of the same. The latter are distributed at intervals over its entire surface.

BUTEO INSIGNATUS.

Buteo insignatus, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 102.
" " " Illust. Birds of Cal. 1854, p. 198.
Vulg. — *The Canada Buzzard. The Brown Buzzard.*

In the collection of eggs obtained in California by Mr. Emanuel Samuels were two eggs of a Hawk which he had no doubt belonged to a bird of this species. The parent was shot on the nest, but escaped into a deep ravine below, and was not obtained. As the egg is different from that of any other Hawk that I am aware of, it has been included among the illustrations, and assigned to this bird, on the strength of Mr. Samuels's impressions. It should be added, however, that his view of the bird was necessarily imperfect, and he may have been mistaken in regard to it. It is possibly the egg of *Buteo bairdii*, perhaps a variety of *B. swainsoni*, or it may belong to the *B. elegans*, all of which bear sufficient resemblance to the *B. insignatus* to be confounded with it, without an opportunity of closer inspection than he possessed. The nest was on a large white-oak, over a deep ravine, on St. Antonio Creek, near Petaluma. It was very large, was constructed of coarse sticks, and was at least sixty feet from the ground.

In regard to the habits and the geographical distribution of this Hawk, but little is known to naturalists. It was first described from a specimen belonging to the Natural History Society of Montreal, and obtained in that vicinity. Specimens have since been met with in California; but to what extent it is distributed through the intervening country remains to be ascertained. It is not improbable that it is a more common species on the Pacific coast, and that it is of rare and accidental occurrence in the eastern part of the continent. Dr. Heermann has ascertained that this Hawk rears its young in California, where he met with both adult and young specimens of this species.

The egg represented in the plate (Plate III, fig. 27), and which is supposed to be that of this Hawk, measures $2\frac{4}{16}$ inches in length by $1\frac{4}{16}$ in breadth. Its shape is an oblong oval, and neither end is perceptibly larger than the other. The ground

color of the egg is a cream-white, but little obscured by markings or secondary colors. The egg is marked, chiefly at one end, with lines, dottings, and small blotches of a light reddish-brown. The lines with which one end of the egg is sparingly marbled are much darker, and are more nearly of a Vandyke-brown. The greater portion of the egg, especially that which corresponds with the smaller end, is free from any markings. This has no close resemblance to any other American Hawk's egg that I have ever met with, but most nearly approaches the egg of the Rough-legged Falcon from Labrador. (Plate III, fig. 29.)

ARCHIBUTEO SANCTI-JOHANNIS.

Falco sancti-johannis, Gmelin, Syst. Nat. I, 1788, 273.
" " Bonap. Syn. 1838, p. 32.
Falco spadiceus? Gmelin, Syst. Nat. I, 1788, 273.
Falco novæ-terræ, " " " " 274.
Falco niger, Wils. Am. Orn. VI, 1812, 82.
Falco lagopus, Wils. Am. Orn. V, 1812, 216, pl. liii, figs. 1 and 2.
" " Aud. Orn. Biog. II, 1835, 377; V, 217, pl. ccccxxii.
Buteo ater, Vieill. Nouv. Dict. IV, 1816, 482.
Butaetes sancti-johannis, Bonap. Geog. and Comp. List, 1838, p. 3.
Buteo lagopus, Aud. Syn. 1839, p. 8.
" " " Birds of America, I, 1840, 46, pl. xi.
Archibuteo sancti-johannis, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 103.
Vulg. — *The Black Hawk. Rough-legged Hawk. Rough-legged Buzzard.*

This species is restricted, during the breeding season, to the more northern parts of North America. I am not aware that it has been with entire certainty ascertained to breed within the United States. It was found in Oregon by Mr. Townsend, where it probably breeds. At other seasons of the year it is found nearly throughout the whole American continent, with the exception only of the more southern portions. It breeds from the Canadas throughout the northern parts of North America, although Mr. Audubon did not meet with its nest on his visit to Labrador, which is not a little singular, as I am assured it is quite common on that coast. I have in my possession the drawing of an egg obtained in Labrador, for the loan of which I am indebted to Dr. James Trudeau. It was said to have been taken from a nest in a tree, and not on a cliff, the usual breeding-place of the *A. lagopus*.

Of the nest of this Hawk, which must not be confounded with the next species, from which I believe it to be quite distinct, the following account, given by Sir John Richardson (*Fauna Boreali-Americana*, p. 52), is the only one I have seen. He says: "A pair were seen at their nest, built of sticks on a lofty tree, standing on a low, moist, alluvial point of land, almost encircled by a bend of the Saskatchewan." We do not know that this species breeds exclusively on trees, or that the *lagopus* confines itself to rocky cliffs. Our knowledge on both points is too limited to enable

us to speak of the results of our observations and inquiries as establishing their specific habits. Indeed, the European *lagopus*, supposed to be identical with our bird, is said to breed on trees as frequently as on cliffs.

The marks of distinction between immature birds of this species and the Rough-legged Falcon have not been so well defined as to make it possible to speak with certainty of the habits of each, as given by authors. We cannot always be sure which species these descriptions are meant to designate.

The egg of the *sancti-johannis* of which I have the drawing measures $2\frac{4}{16}$ inches in length by $1\frac{5}{16}$ in breadth; it is larger than any of the *lagopus*, American or European, that I have seen, and is differently marked. The ground color is a clear cream-white, and is marked, chiefly about the larger end, with dashes and blotches of a light umber, and by other markings, of a deeper shade, of olive-brown. These spots are each distinct, separate, and well defined, and are intermingled with each other in noticeable contrast.

Since the above was prepared, I have been favored by Mr. John Krider, an experienced and well-informed ornithologist of Philadelphia, with the loan of an egg obtained in New Jersey, which there seems to be no good reason to doubt is the egg of this Hawk. The person who obtained it did not secure the parent bird, but claimed to have had a close inspection of it, and described it as a black Hawk, with other points of resemblance such as to leave no doubt with Mr. Krider that it is the egg of the *sancti-johannis*. The nest was in a tree, and contained two eggs. They varied slightly from each other in the number and depth of color of their markings. The one not figured was marked more at the larger end, with darker blotches, and less generally distributed. The one represented in the plate (Plate III, fig. 28) measures $2\frac{1}{16}$ inches in length by $1\frac{1}{16}$ in breadth. Both have many points of resemblance to the drawing, yet vary considerably, most particularly in their smaller size and more ovoid shape. Their ground color is a brownish or yellowish shade of white. Intermixed with the ground are faint markings and blotches of a brownish-purple. Over these are diffused a large number of confluent blotches of russet-brown. These form a ring around the smaller end, which is undoubtedly an exceptional peculiarity. The russet-brown color may be obtained by an equal mixture of burnt-umber and terra-sienna. This egg approximates very closely in its size, color of its markings, and general appearance, to the egg of the *A. lagopus* from Switzerland referred to on page 37.

ARCHIBUTEO LAGOPUS.

Falco lagopus, Gmelin, Syst. Nat. I, 1788, 260.
" " Wils. Am. Orn. IV, 1812, 59, pl. xxxiii, fig. 1.
" " Bonap. Syn. 1828, p. 32.
" " Rich. & Swains. F. B. A. II, 1831, 52.
" " Aud. Orn. Biog. II, 1835, 377, pl. clxvi.
Archibuteo lagopus, Gould, Birds of Europe, I, pl. xv.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 104.
Vulg. — *The Rough-legged Hawk. Rough-legged Falcon.*

As no specific differences are observable between this and the European species, I see no good reason for not regarding them as identical, though it has been usual to consider our *lagopus* as the immature bird of the preceding.[1] The observations of my nephews, Dr. H. R. Storer and Mr. F. H. Storer, in Labrador, satisfied them that these species are not mature and immature birds of the same species, but quite distinct birds in their character, habits, and general appearance. The Black Hawk is a bold, spirited bird, easy and swift in its motions, preying upon other birds. The Rough-leg is comparatively sluggish, inoffensive, and tamable, feeding upon mice, rats, frogs, and other inferior game. With their views I am disposed to accord.

To the supposition that it is the young or immature bird of the preceding species, I object, that the egg of the *sancti-johannis* is manifestly different from that of the *lagopus*, and that, so far as it is known, the mode of nesting of the two birds is also unlike. The American representative of this species breeds on rocky cliffs near the sea; the European is said to nest in trees.

The only egg of the *lagopus* that has been obtained in this country, so far as I am aware, was taken by my nephew from a nest on the cliffs, near the harbor of Bras-d'Or, on the coast of Labrador. The nest contained at the time three young birds, besides one egg unhatched. The young Hawks were just ready to fly, and forsook the nest when approached. As they flew, they rolled out an unhatched egg to the bottom of the cliff, but fortunately without destroying it. The nest was rudely constructed of sticks, and was on a high rock, over the water. Below it the cliff was steep and inaccessible, but was easily approached from above. In the nest at the time were four or five of the large rats peculiar to Labrador, procured by the old birds for their young. In this case, the parent birds were ascertained to be in the plumage of the *lagopus*. At the same time, a young bird, taken alive by one of the sailors of the party, and evidently a *sancti-johannis*, was quite black, even in its immature plumage, and was fierce, untamable, and in all its characteristics very different from the Rough-legged.

In the breeding season this Hawk is found only in the more northern parts of the continent. In the winter, however, it is to be met with nearly throughout the

[1] Mr. Cassin, in his Synopsis of the Falconidæ, gives the *lagopus* as a distinct bird, at the same time remarking that it is usually regarded by naturalists as the young of the *sancti-johannis*, and adds that his only reason for giving it thus is, that, after careful comparison and examination of numerous specimens, he finds it absolutely impossible to distinguish it by any character whatever from the European bird.

United States. Its southern limits in the breeding season have not been determined.[1] Its abundance in California, as observed by Dr. Gambel, leads to the inference that it is an inhabitant of that State throughout the year, as it is also of Washington and Oregon Territories. It was obtained by Dr. Kennedy on the Zuni River in New Mexico. From this we may very safely infer that it is to be found very nearly throughout North America.

The egg of the Rough-legged Hawk from Labrador measures $2\frac{1}{16}$ inches in length by $1\frac{14}{16}$ in breadth, and is nearly spherical. The ground color is a soiled white or a light drab, and is marked with a few faint, ill-defined spots of light-umber, distributed at intervals over the entire surface.

Of four European specimens in my collection, two are so nearly like the American, that the same description would answer for both. They are a trifle larger, but their color and markings are exactly the same. These eggs vary from $2\frac{4}{16}$ to $2\frac{2}{16}$ inches in length, and the breadth of each is $1\frac{12}{16}$ inches.

In one of the other specimens the ground color is of a deeper shade of dingy white, with larger blotches, and its purplish-slate markings intermingled with those of umber. It measures $2\frac{3}{16}$ by $1\frac{13}{16}$ inches.

The fourth is from Switzerland, and varies from all others of the species I have seen. It is marked over a cream-colored ground with very numerous and quite large blotches of different shades of umber and sepia-brown. It measures $2\frac{4}{16}$ by $1\frac{15}{16}$ inches.

ARCHIBUTEO FERRUGINEUS.

Buteo ferrugineus, Lichtenstein, Trans. Berlin Acad. 1838, p. 428.
Archibuteo regalis, Gray, Gen. of Birds, 1849, pl. vi.
Archibuteo ferrugineus, Cassin, Illust. Birds of Cal. 1854, p. 159, pl. xxvi.
" " " Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 104.
" " " Proc. Phil. Acad. 1855, p. 277.
Vulg. — *The Western Rough-legged Buzzard.*

I am unable at present to give any illustration of the egg of this recent addition to our North American Fauna. Mr. E. M. Kern was the first to bring home specimens of this Hawk, and to establish its existence within our limits. Since then, Dr. Heermann has obtained specimens in California of old and young birds, and also of the eggs.

This species was first described by Lichtenstein, in the Transactions of the Berlin Academy, in 1838. It appears to be common throughout California, but of its geographical distribution beyond, nothing is known. The only description of the nest and eggs I have seen is furnished by Dr. A. L. Heermann. He describes the nest as placed in the topmost branches of an oak, composed externally of large twigs, and

[1] In Lieutenant Bland's Catalogue of the Birds of Nova Scotia, it is given as "migratory," and "not common."

lined with coarse grasses and moss. The eggs were two in number; the ground color was white, which was marked with faint brown dashes. Dr. Heermann adds, that the eggs of this species are quite different from those of the European *A. lagopus.*

Since the above was in type, and just as these pages are passing through the press, I have been favored, through the kindness of Dr. Heermann and the attention of Mr. Krider, with the loan of an egg of this Hawk obtained by the former in California. It is represented in Plate III, fig. 26. Its measurements are, length $2\frac{3}{8}\frac{3}{2}$ inches; breadth, $1\frac{1}{1}\frac{1}{6}$. The ground color of the egg is a yellowish-white. This is marked with large blotches of a light, but very distinct, purplish-gray. Interspersed with these are a few light spots and lines of umber-brown.

MILVINÆ.

NAUCLERUS FURCATUS.

Falco furcatus, Linn. Syst. Nat. I, 1766, 129.
" " Wils. Am. Orn. VI, 1812, 70, pl. li, fig. 3.
" " Nuttall, Manual, I, 1832, 95.
" " Aud. Orn. Biog. I, 1840, 368; V, 371, pl. lxxii.
" " De Kay, Nat. Hist. N. Y., Birds, 1844, pl. vii, fig. 15.
Elanus furcatus, Bonap. Syn. 1828, p. 31.
Nauclerus furcatus, Bonap. Geog. and Comp. List, 1838, p. 4.
" " Aud. Syn. 1839, p. 14.
" " Vigors, Zoöl. Jour. VII, 387.
" " Aud. Birds of Am. I, 1840, 78, pl. xviii.
" " Gould, Birds of Europe, I, pl. xxx.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 105.

Vulg. — *The Swallow-tailed Hawk. The Fish-tail Hawk. Le Milan de Caroline* (Cuvier, Regn. Anim. I, 322).

This species has a wide distribution, but except in the Southwestern States does not appear to be anywhere abundant.[1] Its most northern limit on the Atlantic is Pennsylvania and New Jersey, where, however, it is probably of only accidental occurrence. Farther west it is much more frequent, and is found on the tributaries of the Ohio and Mississippi, as far to the north as the State of Wisconsin and the Territory of Minnesota.[2] It is not uncommon in the Atlantic States, from North Carolina south, frequenting the banks of rivers, but not the seaboard. It nests in South Carolina and Georgia, and in all the States which border on the Gulf of Mexico. It also occasionally breeds as far to the northwest as Wisconsin, as I am

[1] Wilson speaks of this Hawk as very abundant in South Carolina and Georgia; but this is contrary to my information. It is found in those States not unfrequently, but rather occasionally than abundantly.

[2] According to Mr. Nuttall, individuals have been seen along the Mississippi as far north as the Falls of St. Anthony, in lat. 44°.

informed, by letter, by Mr. Thure Kumlien, of Fort Atkinson, an intelligent and reliable naturalist. A pair of these Hawks were observed by him in that vicinity, in the summer of 1854. They were evidently breeding, although he was not able to discover their nest.

Mr. Gosse mentions this Hawk as a visitant of Jamaica, on the authority of Mr. Hill, and Dr. Gundlach gives it as a bird of Cuba,[1] although it is not stated that it breeds in either island. It is not clearly ascertained to be a bird of South America, and probably is not found there, except accidentally, unless the species known as *Elanoides yetapa*, which is very similar, proves to be identical.[2] Dr. Woodhouse, in his report upon the birds observed in the expedition down the Zuni and Colorado Rivers, speaks of this Hawk as common in Texas, and also in the country of the Creek and Cherokee nations. He confirms the accounts which have been received of its fondness for the neighborhood of streams, and adds, that along the Arkansas and its tributaries it was very abundant. It does not appear to have been observed in California by either Dr. Gambel or Dr. Heermann. It is a great wanderer, and instances are on record of its occurrence even in Europe, where, however, its appearance is only an accident, and does not justify its being classed as a European bird.[3]

This Hawk constructs its nest on tall trees, usually overhanging or near running water. The nest is like that of the Crow in its general appearance. It is constructed externally of dry twigs and sticks, intermixed with which are great quantities of the long Spanish moss peculiar to the Southern States. The nest is lined with dry grasses, leaves, and feathers.

The eggs are described by Mr. Audubon as from four to six in number, of a greenish-white color, with a few irregular blotches of dark brown at the larger end. I have in my possession the drawing of an egg obtained by Dr. Trudeau in Louisiana, and which was made by that gentleman. It is very nearly spheroidal, and its measurements are, length $1\frac{12}{16}$ inches, breadth $1\frac{9}{16}$ inches. It corresponds with Mr. Audubon's description of the egg of this Hawk.

I am greatly disappointed in being compelled to dismiss this species for the present without the illustration of a single egg. It breeds, with more or less frequency, on the banks of the rivers of nearly all the Southern States. My friend, Dr. Kollock, of Cheraw, S. C., has made repeated efforts to obtain the egg of this Hawk, but thus far has been too late for them. In May, 1855, he succeeded in finding a nest, and ascended to it; but, to his great disappointment, it was found to contain only young. This fact, however, is not without its value, as it fixes the period at which their incubation commenced at about the 1st of April, which is very nearly as soon as they are usually observed to make their appearance in that part of the country. The nest was on a large tree, not near the trunk, but on one of its projecting branches, and somewhat difficult of approach.

[1] It is not given as a Cuban bird by Lembeye, in his *Aves de la Isla de Cuba*.

[2] According to Viellot, it is found in Peru, and even as far south as Buenos Ayres. This may refer to the present species, or, as is supposed, to a very similar but distinct one.

[3] Two specimens are said to have been captured in Europe. One of these was in Argyleshire, Scotland, in 1772. The other in Yorkshire, England, in 1805.

ELANUS LEUCURUS.

Falco dispar, Temm. Pl. Col. I, 1820, Div. 54.
" " Bonap. Syn. App. 1828, p. 435.
" " Nuttall, Manual, I, 1832, 93.
" " Aud. Orn. Biog. IV, 1835, 397, pl. ccclii.
Elanus leucurus, Bonap. Geog. and Comp. List, 1838, p. 4.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 106.
" " " Birds, Gilliss's U. S. Nav. Astr. Exp. II, 1835, 175.
Milvus leucurus, Vieill. Nouv. Dict. XX, 1818, 563.
Elanus dispar, Aud. Syn. 1839, p. 13.
" " " Birds of Am. I, 1840, 70, pl. xvi.
" " Gay, Fauna Chilena, Aves, 1854, p. 33, pl. ii.
Falco melanopterus, Bonap. Jour. Acad. Phila. V, 28.
" " " Syn. 1828, p. 31.
" " " Am. Orn. II, pl. xi, fig. 1.

Vulg. — *Black-shouldered Hawk. Black-winged Hawk. White-tailed Hawk. Bailairin* (Chile).

Although this species is quite abundant in the Southern States, from South Carolina south and west, and equally common in California, I am not able to illustrate its eggs, nor am I aware that any naturalist has discovered or described them, with the exception of Lieutenant Gilliss, who met with them in his recent naval astronomical expedition to Chile. Mr. Audubon, quoting Mr. Ward, states that the nests of this Hawk are placed on low trees, near the margins of rivers, and resemble those of the Crow, but with none of the substantial lining of that bird's nest. He says nothing of their eggs.

Mr. Nuttall, who incorrectly states that they are only seen in the United States in Florida, and then only occasionally, adds, that they build in the forks of trees a broad and shallow nest, lined internally with moss and feathers, and lay four or five eggs, but gives no description of them.

This species has been met with in South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas, and probably also in Mexico and New Mexico. Dr. Gambel describes them as very abundant in California, where I am informed they are familiar in their habits, and breed in clumps of oaks, in the immediate vicinity of habitations. Dr. Heermann speaks of them as common in that State. But neither of these naturalists appears to have met with their nests or eggs. It is not mentioned either as a bird of Cuba or Jamaica by Mr. Lembeye, Dr. Gundlach, or Mr. Gosse.

Mr. Gilliss obtained specimens of this bird in Chile, and Mr. Cassin, in his report upon the birds obtained in that expedition, infers from this that the species "has an extensive range of locality, embracing the southern portion of the United States, Mexico, Central America, and the countries of Western South America.

The only knowledge we have of its eggs is derived from the notes of Lieutenant

Gilliss,[1] from which we learn that the nest is composed of small sticks, and that the female lays from four to six eggs, of a dirty white, with brownish spots.

ICTINIA MISSISSIPPIENSIS.

Falco mississippiensis, Wils. Am. Orn. III, 1812, 80.
Falco plumbeus, Bonap. Syn. 1828, p. 90.
" " Nuttall, Manual, I, 1832, 92.
" " Aud. Orn. Biog. II, 1835, 108; V, 374, pl. cxvii.
Ictinia plumbea, Bonap. Geog. and Comp. List, 1838, p. 4.
" " Aud. Synopsis, 1839, p. 90.
" " " Birds of Am. I, 1840, 73, pl. xvii.
Ictinia mississippiensis, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 106.
Falco ophiophagus, Vieill. Nouv. Dict. XI, 1817, 103.
Vulg. — *The Mississippi Kite.*

The extent of the localities visited by this species is not well ascertained. The *Ictinia plumbea* of South America, with which it has been confounded, has been ascertained to be quite a distinct species. This leaves us without any present means of ascertaining how far its distribution may extend beyond Central America. It is found in the Southern States, from South Carolina south and west, but is most abundant about the Mississippi River. It was first discovered by Wilson, near Natchez, where he found it quite abundant. Mr. Say afterwards observed it far up the Mississippi, at one of Major Long's cantonments. In Captain Sitgreave's expedition to the Zuñi and Colorado Rivers, it was found exceedingly abundant in Eastern Texas, as well as in the Indian Territory, more particularly on the Arkansas River and its tributaries.

According to Mr. Audubon, the nest of this species is always placed in the upper branches of the tallest trees. It resembles a dilapidated Crow's nest, and is constructed of sticks slightly put together, Spanish moss, strips of pine bark, and dry leaves. The eggs are three in number, nearly globular, and are described by Mr. Audubon as of a light greenish tint, blotched thickly over with deep chocolate-brown and black.

The same writer mentions that a pair of these Hawks, whose nest was visited by a negro sailor, manifested the greatest displeasure, and continued flying with remarkable velocity close to the man's head, screaming and displaying the utmost rage.

Having only a drawing, and without access to any authenticated specimen, I cannot

[1] The eggs of this Hawk remain desiderata, and for the present our knowledge of their peculiarities is limited to the above very brief description. My friend Lieutenant Gilliss has, however, very kindly exerted himself to procure me specimens from Chile, while other friends in California hold out similar hopes. I trust that I may be able, in a supplementary number, to illustrate not only the eggs of this species, but also those of several others of this family, in regard to which nothing is now positively known.

illustrate the egg of this Hawk. The specimen represented in my drawing was taken in Louisiana by Dr. James Trudeau, to whom I am indebted for the copy. It measures, length, $1\frac{9}{16}$ inches; breadth, $1\frac{1}{4}$ inches. Its ground color is a greenish-white, and the egg is thickly marked over its entire surface by irregular blotches of olive-brown, dark slate-green, and purplish-drab colors.

CIRCUS HUDSONICUS.

Falco hudsonicus, Linn. Syst. Nat. I, 1766, 128.
Falco uliginosus, Gmelin, Syst. Nat. I, 1788, 278.
" " Wils. Am. Orn. VI, 1812, 67, pl. li, fig. 2.
Falco cyaneus, Bonap. Am. Orn. II, 30.
" " Nuttall, Manual, I, 1832, 109.
" " Aud. Orn. Biog. IV, 1838, 396, pl. ccclvi.
Buteo cyaneus, Rich. & Swains. F. B. A. II, 1831, 55.
Strigiceps uliginosus, Bonap. Geog. and Comp. List, 1838, p. 5.
Circus cyaneus, Aud. Synopsis, 1839, p. 19.
" " " Birds of America, I, 1840.
Falco europogistus, Daudin, Traité, II, 110.
Circus hudsonicus, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 108.
Vulg. — *The Marsh-Hawk. American Hen-Harrier. The Common Hen-Hawk.*

This Hawk is one of the most widely distributed birds of North America, breeding from the fur regions around Hudson's Bay to Galveston, Texas, and from Massachusetts to Oregon and California. It is abundant everywhere, with the exception of the southeastern portion of the United States. Sir John Richardson speaks of it as so common on the plains of the Saskatchewan, that seldom less than five or six are in sight at a time (in latitude 65°). Mr. Townsend found it on the plains of the Columbia River and on the prairies bordering on the Missouri. The Vincennes Exploring Expedition obtained specimens in Oregon. Dr. Gambel speaks of it as common in California, and Dr. Heermann also found it abundant in that State. Dr. Suckley's party obtained specimens in Minnesota; Captain Beckwith's, in Utah; Captain Pope, Lieutenant Whipple, and Dr. Henry, in New Mexico; and Lieutenant Couch, in Tamaulipas, Mexico. Dr. Woodhouse met with it abundantly from the Mississippi River to the Pacific Ocean, throughout the summer, showing conclusively that it breeds in those different sections of country. De la Sagra, Lembeye, and Dr. Gundlach all give it as a bird of Cuba, but not as breeding there.

Richardson (*Fauna Boreali-Americana*, p. 55) states that all the nests of this Hawk observed by him were built on the ground by the side of small lakes, of moss, grass, feathers, and hair, and contained from three to five eggs, of a bluish-white color, and unspotted. They measured an inch and three quarters in length, and were an inch across where widest. In regard to the position and manner of constructing the nest,

this corresponds with my own experience, but not so with respect to the size of the eggs. The nests have been invariably on the ground, near water, built of dry grass, and lined with softer materials.

Mr. Audubon found this Hawk breeding on the barrens of Kentucky, the cleared table-lands of the Alleghanies, and in the high covered pine-barrens of the Floridas. Having considerable doubts whether any American writer who had spoken of the Marsh Hawk had ever seen one of its nests, this same writer gives a very minute account of one which he found on Galveston Island, Texas. It was about a hundred yards from a pond, on a ridge just raised above the marsh, and was made of dry grass; the internal diameter was eight, and the external twelve inches, with the depth of two and a half. *No feathers were found.* If, however, by dwelling upon their absence, Mr. Audubon intended to cast any discredit upon Sir John Richardson's accuracy in his description of the nests of this species, as seen by him, because the latter speaks of feathers having been employed, I am convinced he really had no good grounds. A warm lining to a nest may be required in a climate of latitude 65° north, while the same necessity will not be found in one of 29°. A nest observed in Concord, Mass., by Dr. H. R. Storer, was on the edge of a pond, and was warmly lined with feathers and fine grasses. Many other instances might be named, but one well-attested example is sufficient.

Mr. Audubon speaks of the eggs found in the Galveston nest as four in number, smooth, considerably rounded or broadly elliptical, bluish-white, an inch and three quarters in length, and an inch and a quarter in breadth. Another nest, found under a low bush on the Alleghanies, was constructed in a similar manner, but was more bulky, the bed being four inches above the earth, and the egg slightly sprinkled with small marks of pale reddish-brown.[1]

One egg represented in the plate was obtained on Galveston Island, by Mr. Audubon. Three others in my collection were taken, one in New Jersey, by Mr. John Krider, of Philadelphia, one in Louisiana, by Dr. Trudeau, and one in Concord, Massachusetts. The first, which is one of the four referred to above, is marked on the shell, in Mr. Audubon's handwriting, "April 29, 1837, Galveston Island." Its color is rather a soiled than a bluish white, and its exact measurements are, length, $1\frac{10}{16}$ inches; breadth, $1\frac{5}{16}$. The third measures $1\frac{14}{16}$ by $1\frac{7}{16}$ inches; and the last $1\frac{14}{16}$ by $1\frac{6}{16}$ inches. Their color is white, with a very slight shade of bluish, and faintly marked with brown. They are much longer than the one obtained by Mr. Audubon,—almost enough so to be suggestive of specific differences. Their shape is also different, both being more pyriform, especially the specimen from Massachusetts, which is quite pointed at the smaller end. The last was obtained early in June.

Since the above was prepared for publication, I have received, through the

[1] I think that a more careful scrutiny of the egg of this Hawk may show that the prevalent impression of the absence of spots and markings will prove to be an error. All that I have seen, except the one referred to from Louisiana, are more or less marked with light-brown blotches. These markings are not always very distinct, but so far as my present experience goes, they are to be found if carefully sought.

attention of Dr. Robert Dixon, of Damariscotta, Maine, the contents of the nest of a Hawk of this species. There are several facts in connection which are worthy of consideration. The female was shot as she flew from the nest; there is, therefore, no question as to the identity of the eggs, of which there were six, contained in the nest. With but a single exception, all these eggs are very distinctly blotched and spotted. This, to us, presents an entirely new feature in their markings, although Mr. Audubon (Birds of America, 8vo, I, 108) mentions finding a nest on the Alleghanies, the eggs of which were slightly sprinkled with small marks of pale reddish-brown. In the present instance, the shape of the eggs is a rather oblong oval, rounded at both ends, the smaller end well defined. They varied in length from 2 to $1\frac{1}{16}$ inches, and in breadth from $1\frac{7}{16}$ to $1\frac{6}{16}$ inches. Their ground color is a dirty bluish-white, which in one is nearly unspotted, the markings so faint as to be hardly perceptible, and only upon a close inspection. In all the others, spots and blotches of a light shade of purplish-brown occur, in a greater or less degree, over their entire surface. In two, the blotches are large and well marked; in the others, less strongly traced, but quite distinct. This has led to a closer examination of eggs from other parts of the country, and nearly all are perceptibly spotted!

The nest was found in a tract of low land, which was also wet and miry, covered with grass and clumps of sedge. On one of the latter it had been constructed. It is described as about the size of a peck basket, circular, and composed entirely of small dry sticks, "finished off or topped out with small bunches of pine boughs." There was very little depth to the nest, or not enough to cover the eggs from view in taking a sight across it. "No feathers were found in or about it. It was simply made of small dry sticks, about six inches thick, with about one inch of pine boughs for finishing off the nest."

The eggs were found about the 20th of May. They contained young at least two weeks advanced, showing that the bird began to lay in the latter part of April, and to sit upon her eggs early in the following month.

The nest was found near the village of Damariscotta, Maine, about twenty miles east of the Kennebec River. The circumstances of chief interest are the number of the eggs, greater than usual in the birds of this family, their markings, the construction of the nest, which was different from any before described, the absence of feathers or any other lining, the point of time at which the eggs were probably deposited, and their size and shape.

That there might be no possible doubt as to the identity of these eggs, the parent bird was sent for examination to my very accurate friend, Mr. Cassin, and his closest scrutiny challenged to its specific markings. After a very careful examination of the bird, he writes, "I cannot detect any character distinguishing it from others which are undoubtedly the common species. It is in rather unusual plumage, a transition or change from young to adult."

AQUILINÆ.

AQUILA CHRYSAETOS.

Falco chrysaetos, Linn. Syst. Nat. I, 1766, 125.
" " Aud. Orn. Biog. II, 1835, 464, pl. clxxxi.
Falco fulvus, Linn. Syst. Nat. I, 1766, 125.
" " Wils. Am. Orn. VI, 1815, 13.
" " Bonap. Syn. 1828, p. 25.
" " Nuttall, Manual, I, 1832, 62.
Falco canadensis, Linn. Syst. Nat. I, 1766, 125.
Falco niger, Gmelin, Syst. Nat. I, 1788, 259.
Aquila chrysaetos, Rich. & Swains. F. B. A. II, 1831, 6.
" " Bonap. Geog. and Comp. List, 1838, p. 2.
" " Aud. Synopsis, 1839, p. 3.
" " " Birds of Am. I, 1840, 50, pl. xii.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1851, p. 109.
Aquila nobilis, Pallas, Zoög. Ross. As. I, 338.
Vulg. — *The Golden Eagle. Royal Eagle. Ring-tailed Eagle. Black Eagle.*

The Golden Eagle of Europe and of North America have been regarded as identical in all works upon the ornithology of the two continents. Mr. Cassin of Philadelphia, whose accuracy in determining species, and whose critical eye in recognizing specific diversities, are so well known, has recently expressed doubts as to the correctness of the supposed identity of these two birds. It is therefore a matter of no small regret, that so little aid can be given towards solving these doubts from the oölogy of the two continents. In both countries the Golden Eagle breeds in remote and nearly inaccessible places, and but little is known of its eggs, especially in regard to those of the American bird, of which I regret that I have only a drawing, made by Dr. James Trudeau, from an egg taken near the Hudson River. It differs essentially from any European specimen, or any descriptions that I have ever seen. The variations in a single instance, however, should not be regarded as decisive of specific distinctions, in a family the eggs of which are often known to present great differences, even among those taken from the same nest.

In its geographical distribution, the Golden Eagle of North America appears to be chiefly confined to the mountainous regions, and the more northern portions, but to be nowhere abundant. Sir John Richardson saw but few individuals in the Arctic regions, nor does he appear ever to have met with its nest. Individual birds on the Atlantic coast have been occasionally obtained, — once as far south as Philadelphia, — but very rarely. It was observed in Oregon by Dr. Townsend, but was not met with in California, either by Dr. Heermann or Dr. Gambel; yet several appear to have been obtained among the mountains of New Mexico by Dr. Henry's party.

A bird was secured alive near Boston, in 1837, by being taken in a trap, which had been set for another purpose. It was purchased for Mr. Audubon, and its life destroyed,

for purposes of anatomical examination, by being let down into a vat highly charged with carbonic acid gas. Its occurrence, however, near the sea-coast is very rare, and even among the mountains it is never found except in occasional pairs. It breeds in the mountainous portions of Maine, New Hampshire, Vermont, and New York, and was formerly not unfrequent among the cliffs of the Hudson River. Steamboats and railroads have, however, nearly driven this wild bird from its romantic retreats in that quarter. In Franconia, N. H., for quite a number of years a pair have occupied a nest on an inaccessible rock, near the top of a mountain, in sight of, and opposite, the Flume House. Repeated efforts have been made to reach its nest, but thus far without success. In the summer of 1855 a renewed attempt was made to scale the precipice over which the shelving rock, on which the nest stands, projects. A party was formed, and although they succeeded in ascending the mountain, which had never been achieved before, they could reach only a point beyond and above, not the nest itself. The attempt to pass to it was abandoned, being regarded as too perilous. The party reported a large collection of bones in its immediate vicinity, with other evidences of the accumulated plunder of many years, as well as a plentiful supply of fresh food at the time visited.

The Golden Eagle usually constructs its nest on the sides of steep, rocky crags, where its materials are coarsely heaped together on a projecting shelf of rock. These consist of large sticks, loosely arranged. In rare instances they are said to have been built on trees in the Western States, where rocky cliffs are not to be met with. The eggs are usually three in number; sometimes two, or only one. Mr. Audubon describes them as measuring $3\frac{1}{2}$ inches in length by $2\frac{1}{2}$ in breadth; the shell thick and smooth, dull white, brushed over with undefined patches of brown, which are most numerous at the larger end. This description is probably not quite accurate in regard to size. The European is presumed to be larger than the American, yet the largest I have ever seen measures but $3\frac{3}{16}$ inches in length by $2\frac{5}{16}$ in breadth. The one represented in the drawing referred to measured $3\frac{3}{16}$ inches in length by $2\frac{4}{16}$ inches in breadth. It was in its shape more elongate than the European egg, and its capacity considerably less than any I have met with. The markings differ in their color from those of well-marked specimens of the European, the latter being of a much more reddish shade of brown. Another European egg in the British Museum, and also one represented in Hewitson's British Oölogy, which closely resembled it, were marked over the entire surface with small but distinct blotches of reddish-brown on a white ground. One in my collection, taken in Scotland, and presented me by H. F. Walter, Esq. of London, is nearly unmarked. A distinctly bluish-white ground is faintly stained with a few very obscure markings of slate and purplish-brown. More information in regard to the variations of both the American and the European eggs, and the degree of uniformity of these variations, is needed, before they can help to throw any sure light upon their specific identity or diversity.

HALIÆTUS ALBICILLA.

Vultur albicilla, Linn. Syst. Nat. I, 1766, 123.
Falco ossifraga, " " " " 124.
Falco melanœtos, " " " " "
Falco albicilla, Bewick, Brit. Birds, I, 1804, 9.
" " Penn. Brit. Zoöl. I, 209.
" " Temm. Man. d'Orn. I, 1820, 49.
" " Montagu, Orn. Dict. 1831.
" " Yarrell, Hist. Brit. Birds, I, 1839, 15.
Aquila albicilla, Flem. Brit. An. p. 53.
" " Jenyns, Brit. Vert. An. p. 80.
Haliœtus grœnlandicus, Brehni, Vog. Deuts. I, 1831, 16.
Haliœtus albicilla, Selby, Brit. Orn. I, 18.
" " Gould, Birds of Europe, I, 1832, pl. x.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 111.

Vulg. — *The Gray Sea-Eagle. The European Sea-Eagle. The White-tailed Eagle. The Cinereous Eagle. The Erne. Cinereous Sea-Eagle. The Sea-Eagle. Aigle pygargue.*

I have not included this among my illustrations of the eggs of North American species, because I have no specimen actually obtained upon this continent. Indeed, its claims to be included in our Fauna rest only upon its supposed existence in the neutral ground of Greenland. I have, however, deemed it best to include a brief description of the markings of its eggs, with some account of its mode of breeding. Further knowledge may possibly authorize us to add it to our list of American birds.

The Sea-Eagle of Europe, as its name implies, frequents the sea-coast of the northern portions of that continent, and is rarely found inland. It builds its nest on rocky cliffs projecting over the water, on the shores of Scotland, the Orkney and Shetland Islands, Norway, Russia, &c. The nest is constructed of sticks, or, where these are not convenient, of sea-weed. The eggs are two or three in number. Their ground color is a clear white, usually unmarked, but occasionally stained with small, faint spots of light-brown. The measurements of two in my collection, both from Scotland, but obtained at different times by H. F. Walter, Esq. of London, are as follows: length $2\frac{1}{1}\frac{1}{6}$ inches, breadth $2\frac{3}{1}\frac{}{6}$ inches; length $2\frac{2}{1}\frac{}{6}$, breadth $2\frac{4}{1}\frac{}{6}$ inches.

The following, in relation to their breeding and distribution, is taken from Mr. Yarrell's excellent work on the Birds of Great Britain: —

"The White-tailed Eagle builds its nest on high rocks, and lays two eggs, about the same size of those of the Golden Eagle, but with very little or no red color on the white ground. The young are at first covered with a soiled-white down; and even at this age, the beaks and claws of the eaglets are of very large size. A pair of Golden Eagles have been known to rear their young in the same spot for eight seasons in succession; and Mr. Mudie has mentioned, that, being thus attached to a particular locality, their young, when able to provide for themselves, are driven away by the parent birds to get their living elsewhere; but the more erratic White-tailed

Eagle, quitting the breeding station when the season is ended, leave their young to forage over the district in which they have been raised. In confinement, the White-tailed Eagle sometimes becomes sociable. . . . . One kept by Mr. Hoy laid three eggs in the same season; and a female in the possession of Mr. Selby laid an egg after having been kept in confinement twenty years. . . . . The White-tailed Eagle breeds in the Hebrides, in Orkney and Shetland. Mr. Dunn, in his useful guide to these latter islands, names the particular localities in which they may be found, but states that they are much more numerous in winter than in summer. This accords with the opinion of M. Temminck and others, that this species returns to the southward from high northern latitudes as the season advances. . . . . This Eagle frequents Denmark, Sweden, the west coast of Norway, and from thence as far north as Iceland and Greenland, but is not found in North America. Mr. Temminck believes that this Eagle follows the flocks of Geese that annually resort to the Arctic regions in summer to rear their young. It is found in Siberia, at Lake Baikal, and inhabits Russia, from whence to the southward it is spread over the European continent generally."

HALIÆTUS LEUCOCEPHALUS.

Falco leucocephalus, Gmelin, Syst. Nat. I, 1788, 255, sp. 3.
" " Wils. Am. Orn. IV, 1812, 89, pl. xxxvi.
" " Bonap. Synopsis, 1828, p. 26.
" " Nuttall, Manual, I, 1832, 72.
" " Aud. Orn. Biog. I, 1832, 160; II, 160; V, 354; pls. xxi and cxxvi.
Falco ossifragus, Wils. Am. Orn. VI, 1812, 16, pl. lv.
Falco pygargus, Daud. Traité, II, 62.
Aquila leucocephalus, Rich. & Swains. F. B. A. II, 1831, 15.
Haliætos leucocephalus, Bonap. Geog. and Comp. List, 1838, p. 3.
Haliætus leucocephalus, Aud. Synopsis, 1839, p. 10.
" " " Birds of America, I, 1840, 57, pl. xiv.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 111.
Vulg. — *The Bald Eagle. The White-headed Eagle. Le Pygargue à Tête Blanche* (Buffon). *Aigle à Tête Blanche* (Cuvier).

The White-headed, or, as it is also incorrectly called, the Bald Eagle, is widely diffused throughout the North American continent, from at least latitude 66° 34′ north, to the Gulf of Mexico and Central America. It is also of accidental occurrence in Europe. Temminck records two specimens as having been obtained in Central Europe, one in Zurich in Switzerland, the other in the kingdom of Wurtemberg. He also speaks of this species as frequenting the North of Europe, and in his latest edition, on the authority of Mr. Boie, states that they breed on some of the Norwegian islands. Their accidental occurrence in Central Europe may perhaps be readily accounted for by the escape of birds who had been in confinement. Their frequenting Northern Europe, excepting as chance visitants, needs confirmation.

Sir John Richardson, in *Fauna Boreali-Americana*, Vol. II, p. 15, states that he did not meet with this species north of 62°, although he speaks of finding them common between that point and Lake Superior. He also states that they leave the fur countries in October, when the rivers are frozen, and expresses the opinion that their nests are more numerous in these regions than in the United States. In the last point he is probably mistaken. Their nests are undoubtedly more common in the South Atlantic States than anywhere else. Subsequently, in his expedition over land to the Arctic Seas, in 1848, his observations in regard to this bird differ materially from his first impressions. He found this Eagle abundant at Half-moon Lake, in latitude 56° north.[1] He also speaks of finding both the Osprey and White-headed Eagle building their nests on the banks of Bear Lake River, in about 60° north. At Fort Confidence, latitude 66° 54′, we find in his notes, that White-headed Eagles made their appearance as early as May 17th, before the ice had given way in the rivers; and in his tables of phenomena observed at the Cumberland House, in latitude 54°, we also observe that a White-headed Eagle was seen as early as the 24th of March, "being almost always the first of the summer birds which arrives."

Dr. Woodhouse found this Eagle, though nowhere very abundant, from the Gulf of Mexico to the Pacific, in the expedition to the Zuñi and Colorado Rivers. Dr. Gambel found it common in California, breeding on the rocky cliffs of its Pacific coasts early in February. Dr. Townsend also met with it in Oregon, and Dr. Cooper's party in Washington Territory.

It breeds along the Atlantic coast from Maine to Florida, and thence along the Gulf of Mexico to the Rio Grande. It has not been observed either in Cuba or Jamaica. It constructs its nest somewhat in accordance, both as to time and place,[2] with the climate,[3] and other peculiarities of the locality. For the most part these are placed on trees, but in California it resorts, in preference, to the rocky cliffs of the sea-coast; and in the fur countries Sir John Richardson noticed the same deviations from its usual habits. Mr. Audubon, after Dr. Richardson had made public

[1] Sir John Richardson also states: "This Fishing Eagle abounds in the watery districts of Rupert's Land, and a nest may be looked for within every twenty or thirty miles. Each pair appropriates a certain range of country, on which they suffer no intruders of their own species to encroach; but the nest of the Osprey is often placed at no great distance from that of the Eagle. Some of our voyagers had the curiosity to visit an Eagle's nest, which was built on the cleft summit of a balsam poplar, of sticks, many of them as thick as a man's wrist. It contained two young birds, well fledged, with a good store of fish, in a very odoriferous condition. While the men were climbing the tree, the female parent hovered close around, and threatened an attack on the invaders; but the male kept aloof, making circles high in the air."

[2] In California, where the rocky coast is destitute of convenient trees, the White-headed Eagle resorts to rocky cliffs as the safest and most convenient places for nesting. We have the authority of Sir John Richardson for the same deviation from its usual resort to trees, in parts of the fur countries where the latter are wanting.

[3] The climate apparently exerts some influence, though not so much as might be supposed. In the Southern States this Eagle nests seven weeks earlier than in Maine, in both of which regions they are resident throughout the year. Farther north, where the severity of the cold, by closing the ponds and rivers with solid ice, places their food beyond their reach, and where they are only visitants in the warmer season, they of course breed still later, for the reason that they do not reach these regions until after the breeding season of more southern birds of the species.

his own observations, repeats the statement that this Eagle *is never known to nest on rocks.*[1]

In the extreme Southern States, as in California, the White-headed Eagle breeds as early as February. In Maine, the general impression is that the eggs are not deposited before May, and at a still later period in the more northern portions of the United States. More recent observations show this to be incorrect, and leave hardly a doubt that these birds breed at a much earlier season of the year than is generally supposed, and greatly in advance of most of their family. Mr. Audubon speaks of having once shot a female on her eggs, near the Mississippi, as early as the 17th of January. Dr. Gambel found White-headed Eagles nesting on the cliffs along the shores of the Pacific in February and March. Relying upon the information I had generally received from others, I supposed that in the New England States their incubation commenced at a somewhat later period. Some facts, however, which came to my knowledge the present season (1856), assure me that even there the amatory season of the White-headed Eagle is in the most inclement portion of the winter.

Having occasion to visit the State of Maine in April, 1856, near the Damariscotta River, the banks of which stream are frequented by these birds on account of the abundance of fish, I received information which is materially inconsistent with my previous impressions. I was informed, by a person who had long observed them with some attention, that a pair had constructed a nest in a neighboring wood, which they had occupied for several successive years. The previous season (1855), late in May, he had climbed a tree in the immediate neighborhood, commanding a full view of the nest. It then contained young, nearly grown. From this statement I was led to conclude that the female must have deposited her eggs at some period in March, if we allowed four weeks for incubation, and as many more for the growth of the young eaglets, and that there was no time to be lost if we would secure the eggs before hatching. We accordingly visited the nest on the 27th of April, and found it situated on a tall pine, at least sixty feet from the ground. The tree stood in a swampy wood, within a few rods of the stage road, and not more than half a mile from the village of Damariscotta. It contained no limbs or branches to facilitate ascent for at least the distance of thirty feet, and the trunk at the base was from six to nine feet in circumference, rendering it impossible to mount the tree by the aid only of the hands and feet. My assistant was, however, drawn up by means of a rope fastened round his body, the other end having been thrown over a fork in the trunk, which occurred at the height of some eighteen feet, and from which point the tree assumed the shape of two tall and perpendicular columns. Having been aided in climbing to this fork, the rope was again thrown over the nearest branch, about twelve feet above his head, and our adventurous climber was again raised, by the aid of those on the ground, to a height where the branches of the tree rendered the remainder of the ascent comparatively easy.

While he was ascending, we observed several Eagles flying over our heads, but at

[1] Birds of America, (8vo,) I, 61.

a great height. One only approached us, but as soon as we were noticed, the bird made a precipitate retreat. It was apparently conveying food to the nest, and was not at first aware of our presence; after which it hovered at a distance, suggestive of more prudent caution than of parental devotion or courage, uttering hoarse, disagreeable cries of displeasure, not unlike imperfect barkings of a dog. No attempt was made to molest or interrupt the man as he ascended to, or after he had reached the nest, which we supposed to be unoccupied. We were however surprised to find, when he had climbed to the nest, that the female had been sitting upon it all the while, and only left when the unwelcome caller was near enough to have reached the bird with his hands. She too flew over the man's head in somewhat closer proximity, uttering frequent cries of distress, but made no effort whatever to attack him. On the contrary, her whole behavior seemed to evince a cowardice and want of spirit very different from that which we usually associate with Eagles when it becomes their parental duty to defend their young.

To our disappointment, the nest was found to contain no egg, and but a single bird, apparently about a fortnight old. It was some six or seven inches in length, its weight between one and two pounds, and its head and claws disproportionately large. It was covered uniformly with a thick, close, and soft downy plumage, which was of a clean deep straw-color. There was not the least admixture of gray or brown.[1] The young bird was completely helpless, and uttered almost constant cries for food. It ate readily whenever fish or meat was offered it, but was unable to support itself upon its legs. It was taken to my host's house, where it was well cared for, and for a while, with careful attention, it did well and grew apace, ever manifesting a most inordinate and ever insatiable appetite for fish and flesh.

The nest was described to me by my assistant as a platform between five and six feet in diameter, and at least four in thickness. It was constructed of regular layers of large sticks, each several feet in length, and from an inch to an inch and a half in thickness. Its surface was perfectly flat, and was "finished off," to use his expression, with tufts of grass, dry leaves, mosses, lichens, small twigs, &c., &c. He found in it, by the side of the young Eagle, four or five large eels, each of which was about two feet in length, showing that the parent birds provide liberally for their own wants and those of their young.

Estimating the age of the young Eagle at ten days, and allowing four weeks for incubation, and at least one week's interval between the deposition and the commencement of the parent bird's sitting upon it, we have very nearly the exact period at which the egg was laid, March 13th. It is interesting to notice, in this

[1] Mr. Audubon describes "the young birds, when not larger than middle-sized pullets," as "covered with a soft, cottony kind of down," and adds, that "their first plumage is of a grayish color, mixed with brown, of different depths of tint." This is a little obscure, but I presume Mr. Audubon intended by "first plumage," not the downy covering of which he speaks, but that which succeeds to it. The color of the down has no gray or brown, but is as described above.

connection, that this occurred at the coldest period of the season, when the ground was covered with snow to an unusual depth, and when the thermometer indicated a temperature at that time frequently as low as 15° below zero. With the exception of the Common Crossbill (*Loxia americana*), a pair of which birds once constructed a nest on a leafless elm early in March, in Vermont, this is the only instance I have ever known of incubation so apparently unseasonable.

The apathetic conduct of the parent birds, especially of the female, is also worthy of notice. Taken in connection with Sir John Richardson's account of a most unparental lack of spirit on a similar occasion, it inclines me to the belief that Mr. Audubon gives our White-headed Eagles more credit than they are entitled to, for parental devotion and courage.[1] Certain it is, I have seen the Common Brown Thrush, the Cat-Bird, and even the little Black-capped Titmouse, evince more of both qualities, in defence of their young, than was shown on this occasion by these recreant specimens of our "national emblem." If we may infer its general character from these two instances, the White-headed Eagle is not only an unscrupulous robber, plundering the Fish-Hawks and the Gulls of the fruits of their honest industry, but is also a rank coward, whom not even parental instinct can stimulate to a respectable manifestation of courage.

Its nest is usually of great size, composed of sticks from three to five feet in length, pieces of turf, weeds, and moss. Its diameter is about five feet, and its depth is not unfrequently as great. In the warmer localities, where it breeds, the pair usually frequent the same nest throughout the year, and make it their permanent place of resort. This is also true, probably, wherever this Eagle remains throughout the year.

The eggs are usually two, sometimes three or four, in number, are nearly spherical, equally rounded at either end, and are more or less granulated on their surface. Their color is a dull white, unspotted, but often stained by incubation to a dirty white or a light soiled drab. Two eggs in my collection present the following measurements: length 3 inches, breadth $2\frac{4}{16}$; length $2\frac{14}{16}$ inches, breadth $2\frac{13}{16}$. The first was obtained in New Jersey by Alexander Wilson, the ornithologist; the latter by Dr. Trudeau, in Louisiana. The egg represented in the plate (Plate IV, fig. 37) was taken from a nest in Texas, by Dr. Heermann.

[1] "Of this I assured myself by climbing to the nest every day in succession, during her temporary absence, *a rather perilous undertaking when the bird is sitting*. The attachment of the parents to the young is very great when the latter are yet of a small size; and to ascend to the nest at this time would be dangerous." (Birds of America, 8vo, I, pp. 61, 62.)

PANDION CAROLINENSIS.

Falco carolinensis, Gm. Syst. Nat. I, 1788, 263.
Aquila piscatrix, Vieill. Ois. d'Am. Sept. I, 1807, 29.
Pandion americanus, Vieill. Gal. I. 33.
Falco haliætus, Wils. Am. Orn. V, 1812, 13; pl. xxxvii.
" " Bonap. Syn. 1828, p. 28.
" " Aud. Orn. Biog. I, 1832, 415; V, 362; pl. lxxxi.
" " Nuttall, Manual, I, 1832, 18.
" " De Kay, Nat. Hist. N. Y., pl. viii, fig. 18.
Pandion carolinensis, Bonap. Geog. and Comp. List, 1838, p. 3.
" " Cassin, Syn. N. A. Birds, 1854 (Illust. Birds of Cal.), p. 112.
Pandion haliætus, Aud. Syn. 1839, p. 12.
" " " Birds of Am. I, 1840, 64; pl. xv.
Vulg. — *The Fish-Hawk. Osprey. Carolina Osprey. Fishing Hawk.*

Owing to the confusion which has existed, until recently, in regard to the identity of the Osprey of the Old World with the Fish-Hawk of the New, there has been a corresponding uncertainty respecting the geographical limits of the American species. As their difference can no longer be questioned, we feel justified in assuming that our bird is found only throughout North America, from the fur regions around Hudson's Bay to Central America. According to Mr. Hill, as quoted by Mr. Gosse in his "Birds of Jamaica," it is found occasionally in that island, and, as I learn by letter from Dr. Gundlach, is also occasionally met with in the island of Cuba; but it is not known to breed in either place.[1] Dr. Woodhouse, in his report of the expedition to the Zuñi River, speaks of this Hawk as common along the coasts of Texas and California. The Vincennes exploring expedition obtained specimens in Oregon. Dr. Heermann mentions it as common on the borders of all the large rivers of California in summer, and Dr. Gambel also mentioned it as abundant along the coast of that State, and on its rocky islands, in which latter localities it breeds. I am not aware that it has ever been found farther south than Texas.

To the north it has been met with by Dr. Richardson in the Arctic regions, where its migrations are supposed not to reach the extreme northern limits of the continent. That observing naturalist saw nothing of this bird when he was coasting along the shores of the Arctic Sea, nor did Mr. Hearne meet with it on the barren grounds north of Churchill.

It is found along the entire Atlantic coast, from Labrador to Florida, with the exception of that of Massachusetts around Boston, where it does not breed, and where it is only occasionally met with. It is most abundant from Long Island to the Chesapeake, and throughout this long extent of coast is very numerous, often breeding in large communities, to the number of several hundred pairs. In the interior it is much less frequent, but is occasionally met with on the banks of the larger rivers and lakes, and in such instances usually in solitary pairs.

[1] Since the above was in type, I have received a letter from Dr. Gundlach, in which the *Pandion carolinensis* is marked as one of the birds which "may breed in Cuba."

The American Fish-Hawk, though quite a distinct species from the European Osprey, is yet so very similar to that bird, that several eminent naturalists still continue to regard the two species as identical. Although the Prince of Musignano, in his Comparative List of the Birds of Europe and North America, published in 1838, gave the American bird as a distinct species from the European, Mr. Hewitson in his British Oölogy, and Mr. Yarrell in his History of British Birds, insist upon regarding them as the same species, and quote long extracts, written exclusively in reference to the American bird, as if they were also applicable to the European species. In many important respects, they are not. Even Mr. Temminck, in the latest edition of his Manual, can find no difference between specimens from all parts of the globe, and Sir William Jardine, in the notes to his edition of Wilson, regards the species of both continents, and also the *P. leucocephalus* of Australia, as one and the same. The Australian species is even more distinct from both the European and the American, than these are from each other. This reluctance to acknowledge specific differences, of which there can be no well-founded doubts, has led, and must continue to lead, to much confusion and perplexity, especially as American specimens, both of birds and eggs, are indiscriminately figured and described in books, and ranged in collections, as if identical with the European. What makes this persistence in error the more unaccountable is, that the habits of these species are totally unlike, and these differences of habit have not escaped the notice of naturalists generally.

The American Fish-Hawk is migratory in its habits, leaving our coasts early in the fall of the year, and returning soon after the close of the winter. Sir John Richardson states, that the time of its arrival in the fur regions is as early as April, and on the coast it has been noticed in the middle of March. It breeds on the coast of Nova Scotia late in June, on that of Maine earlier in the same month, and in New Jersey and Maryland in May. In California its nesting is even earlier.

It constructs its nest almost invariably on the tops of trees, and this habit has been noticed even in its extreme northern resorts. The only instance I have known of a deviation was a nest constructed near West Point, New York, observed by my friend, William H. Edwards, Esq., which was built on a high cliff on the banks of the Hudson River. It is a bold and confiding bird, often constructing its nest near a frequented path, or even upon a highway. Near the eastern extremity of the Wiscasset (Maine) bridge, and directly upon the stage road, a nest of this Hawk has been frequented for several years.[1] It stands upon the top of a low pine-tree, is readily accessible, the tree being easily climbed, and is so near the road that, in passing, the young birds have been frequently heard, in their nest, uttering their usual cries for food.

The trees upon which the nests of the Fish-Hawk are built, are for the most part dead or dying, a condition attributed by some to the fish-oil contained in their food, by others to the excrements of the birds, or the mass of salt materials of which the nests are generally in a large part constructed. The nests are usually composed

[1] It was abandoned the last season (1855).

externally of large sticks, from a half-inch to an inch and a half in circumference, and frequently three feet in length. These are often piled to the height of five feet, with a diameter of three. In a nest described by Wilson, he found, intermixed with a mass of sticks, corn-stalks, sea-weed, wet turf, mullein-stalks, &c.; the whole lined with dry sea-grass (*Zostera marina*). All together, he adds, it formed a mass observable to the distance of half a mile. It was large enough to fill a cart and be no inconsiderable load for a horse. None of the nests which I have observed in New England bear any proportion in size to this. They are not usually more than two feet in their greatest depth.

When the nest of this Hawk is visited, the male bird will frequently make violent, and sometimes dangerous, attacks upon the intruder. In one instance, related to me by a physician in Maine, the talons of one of these Hawks penetrated through a thick cloth cap, and laid bare the scalp of a lad who had climbed to its nest, very nearly hurling him to the ground. A correspondent quoted by Wilson narrates a nearly similar instance of courageous and desperate defence of its young. The Fish-Hawks are also very devoted in their attentions to their mates, and supply them with food while on the nest. Wilson relates a touching instance of this devotion, where a female who had lost one leg, and was unable to fish for herself, was so abundantly supplied by her mate, that she rarely had occasion to leave her nest, and never for food.

The Fish-Hawk usually nests in large communities. Even three hundred pairs have been observed nesting in this manner on one small island. When a new nest is to be constructed, the whole community has been known to take part in its completion, and the work is soon finished. These Hawks are also remarkably tolerant towards smaller birds, and permit the Purple Grakle (*Quiscalus purpureus*) to construct their nests in the interstices of their own. Wilson observed no less than four of these nests thus clustered in a single Fish-Hawk's nest, with a fifth on an adjoining branch.

The eggs of the Fish-Hawk are usually three in number, often only two, and more rarely four. They are subject to great variations as to their ground color, the number, shade, and distribution of the blotches of secondary coloring with which they are marked, and also as to their size and shape. Their ground color is most frequently a creamy white, with a very perceptible tinge of red. This varies, however, from an almost pure shade of cream, without any admixture, to so deep a shade of red that white ceases to be noticeable. The specimens represented in the plate correspond with the more usual varieties of the eggs. In the others, which are only verbally described, this variation of the ground color is quite marked, and nearly all the usual shades of brown appear that are observable in their secondary markings. In one instance these markings are of a dark umber-brown, in another of a light claret-brown; in a third there is an intimate mingling of both shades, as also in the fourth, but with a different distribution, and also with an intermixture of purplish-brown. The eggs represented in the plate (Plate III, figs. 33 and 34) vary from $2\frac{9}{16}$ inches to $2\frac{3}{16}$ in length, and from $1\frac{14}{16}$ inches to $1\frac{11}{16}$ in breadth.

It would be impossible, even if it were desirable, to represent all of the endless

varieties of this species. I have therefore confined myself to the illustration of only the two most common, with verbal descriptions of the more frequent varieties. The following descriptions of eight specimens in my collection, not figured, represent also not unfrequent variations from the above: —

Length $2\frac{5}{16}$ inches, breadth $1\frac{2}{16}$; ground color reddish-white, thickly covered, over the whole egg, with large confluent blotches of umber, with a slight mixture of sienna-brown, — at the larger end completely concealing the ground color, and of varying depths of shade, — less in size, and not quite so numerous at the smaller end; shape slightly pyriform.

Length $2\frac{7}{16}$ inches, breadth $1\frac{3}{16}$; ground color white, with only a faint tinge of reddish; marked round the larger end with a wreath of confluent blotches of umber and chocolate-brown; the smaller end nearly unmarked, with only a few dottings of reddish-brown; the rest of the egg marked with a few isolated and irregular dashes of chocolate; in shape oval, the smaller end but slightly more pointed than the larger.

Length $2\frac{6}{16}$ inches, breadth $1\frac{4}{16}$; broadly oval, slightly pointed at smaller end; ground color dirty reddish-white, marked irregularly with large blotches of deep umber-brown, with fainter markings of a slaty drab, intermixed with which are a few smaller dottings of brownish-purple. All the markings are more frequent at the larger end, but distributed in small groups, without being confluent.

Length $2\frac{8}{16}$ inches, breadth $1\frac{1}{16}$; oblong and slender, more than usually pointed at the smaller end, ground color a bright reddish-white, light and uniform in its shade, sparsely marked with a few large blotches of a brownish-red or light brick-color; larger at the extremity, with more frequent small dottings of the same shade, and a few purplish spots. The unmarked ground color occupies more than half its surface.

All of the above four were from New Jersey.

Length $2\frac{7}{16}$ inches, breadth $1\frac{2}{16}$; ground color a light dirty brick-red; marked at larger end by a confluent mass of blotches of a rusty brown, or dark brick-red, completely covering it; the rest only marked by a few scattered and smaller blotches of the same shade; shape pyriform.

Length $2\frac{8}{16}$ inches, breadth $1\frac{3}{16}$; ground color a dirty white with hardly a perceptible shade of reddish; marked at larger end with a confluent ring of dark umber blotches; a few scattered markings of the same distributed at intervals over the rest of the egg, of which the larger part is unmarked.

The last two were taken from the same nest near Halifax, Nova Scotia.

The smallest egg of this species that I have met with measures $2\frac{5}{16}$ inches in length, $1\frac{1}{16}$ in breadth; ground color a beautiful clear white, with the faintest tinge of reddish; nearly unmarked, except at the larger end, which is covered by a mass of confluent blotches of dark umber and chocolate-brown; a few spots of faint purplish-brown and darker umber sprinkled over the rest of its surface.

The largest that I have seen measures $2\frac{9}{16}$ inches in length, $1\frac{4}{16}$ in breadth; the ground color is a creamy white, with a perceptible shade of red; marked with large confluent blotches of dark umber-brown.

One undoubted egg of this bird, in the collection of Mr. Krider, is hardly distinguishable from a common variety of the Caracara Eagle (*Polyborus tharus*).

As there yet exist differences of opinion among naturalists as to the identity or diversity of the European, American, and Australian species, it is interesting, in this connection, to observe how far their eggs correspond, as well as how far the habits of these birds are similar or dissimilar. In regard to the habits of the Australian bird, our information is not so full as could be wished. Specimens of the eggs of this variety in the collection of the Philadelphia Academy, and in my own, obtained by Mr. Gould, are more spherical and larger than the average of the American. Neither end is perceptibly more pointed than the other. Its ground is a pure cream-color, untinged with red, and the surface is beautifully marked with large blotches of dark brownish-purple, intermixed with a few smaller markings of umber, a dark wine-color, and purple; colors and combinations of colors such as I have never observed in any European or American specimens.[1]

The European is smaller than the American, is often, but not always, more spherical, and is less pointed at the smaller end. Among its varieties is one which is quite common, and is very different from any I have ever observed among at least five hundred specimens of the American which I have examined. Of this variety I have one in my collection, obtained in Scotland, and given me, by Henry F. Walter, Esq. of London. Its length is $2\frac{7}{16}$ inches, breadth $1\frac{1}{1}\frac{2}{6}$; it is oblong and oval in shape, the ground color is a dull white, or very light cream-color, *almost unspotted*, and only marked by a few faint spots of light umber around the larger end. Another essentially resembling this is in the collection of Mr. Walter, which was also taken in Scotland. The Philadelphia Academy possesses a third, and Mr. Charles St. John, in his Tour in Sutherlandshire, describes an Osprey's egg which he took from a nest near Scowrie, in the Highlands of Scotland, which is also very similar to mine, but is like no specimen of the American species.[2]

Another Osprey's egg in my collection, taken near Aarhuus, in Denmark, by Rev. H. B. Tristram, of Castle-Eden, Eng., measures only $2\frac{2}{16}$ inches in length,—shorter by a fourth of an inch than the smallest American,—in breadth $1\frac{1}{1}\frac{0}{6}$ inches; its ground color is a rich cream, with a slight tinge of claret, and it is marked over its whole surface with large blotches of a beautifully deep shade of chocolate.

[1] The *Pandion leucocephalus* of Australia is indisputably a distinct species. Unlike our Fish-Hawk, it is nowhere abundant, though widely diffused. Its habits, so far as they are known, are very similar to those of our bird. It constructs a large and conspicuous nest, usually on rocks, occasionally on tree-tops. Mr. Gould, in the Birds of Australia, mentions a nest that was fifteen feet in circumference. In his description of the eggs, besides some marked like the one described above, he also speaks of a common variety which is boldly spotted and blotched with a deep, rich reddish-brown, so dark as to be nearly black, on a yellowish-white ground. No eggs, European or American, correspond exactly with this description.

[2] "We found two beautiful eggs in the nest, of a roundish shape; the color white, with numerous spots and marks of a fine rich red brown. . . . . Mr. Dunbar, with his usual perseverance, went to this nest [the same], and found that the male bird had got another mate [Mr. St. John had shot her former mate], and she was already busily employed in sitting on a single egg. . . . . The two eggs which I took from this nest were beautifully marked with fine rich red spots, while the egg now taken by Dunbar *was of a dirty-white color, marked, at one end only, by a splash of brown*, and was also smaller than the others." (Tour in Sutherlandshire, London, 1849, I, 31, 105.)

In their habits the European and the American birds are much more decidedly different than in their own markings, or in those of their eggs. The American is a very social bird, generally living in large communities during the breeding season. The European is found only in solitary pairs. Never, that I can learn, do more than one pair frequent the same neighborhood. The European frequents almost exclusively fresh water. The American, though found also on large rivers and lakes, is much the most abundant on the sea-shore. The European bird rarely builds on trees, the American almost always. The European bird sometimes "builds on the ground among reeds," the American never. The latter rarely resorts to rocky cliffs to breed, the European almost uniformly. There is no instance on record of the American species attacking smaller birds or inferior land animals with intent to feed on them. The European species is known to prey on Ducks and other wild-fowl.[1] In the construction of their nests, the European and the American species approach more nearly, though the former has been known to build them in a manner of which I know of no instances in this country.[2]

These are some of the more prominent points of difference between the Osprey and the Fish-Hawk. They are sufficiently striking, one would think, to have satisfied naturalists long since of their specific difference, even if no constant variations in size, markings, and other peculiarities of structure, had been noticeable.

POLYBORUS THARUS.

Falco tharus, Molina, Sagg. Stor. Nat. del Chile, 1782.
Falco cheriway, Jacquin, Beytr. Gesch. der Vög., p. 17.
Falco plancus, Müller, Cimelia Physica, pl. xvii.
Polyborus vulgaris, Aud. Orn. Biog. II, 1835, 350; VI, 351; pl. clxi.
" " Vieill. Nouv. Dict. V, 1817, 257.
Polyborus brasiliensis, Aud. Syn. 1839, p. 4.
" " " Birds of Am. I, 1840, 21, pl. iv.
Polyborus tharus, Cassin, Syn. N. A. Birds, 1854 (Illust. Birds of Cal.), p. 113.
" " " Birds of Gilliss's U. S. Nav. Astron. Ex. II, 1855, 173.
Caracara vulgaris, Gay, Fauna Chilena, Aves, 1855, p. 207, pl. i.
Vulg. — *Caracara Eagle. Traro. The Mexican Eagle. Totache. Carrancha.*

This species, which appears more nearly connected with the Vultures than with the Eagles in nearly all that relates to its habits, occurs only in the more southern

[1] "An Osprey was seen to stoop and carry off a young, half-grown Duck from the surface of the water, at Slapton Ley. In the struggle the Duck fell from the talons, but was recovered before it reached the water." (Rennie's edition of Montagu's Ornithological Dictionary, London, 1831, p. 348.)

[2] In Sweden, Oedman states that the Osprey makes its nest in the highest trees, of pine-tops, lined with the leaves of the *Polypodium vulgare*, a structure very different from any our species are known to build.

portions of the United States. It was first observed by Mr. Audubon in Florida, where it is not of uncommon occurrence, and where it is supposed also occasionally, though rarely, to breed. I am not aware that the Caracara has ever been observed in Alabama, Mississippi, or Louisiana,[1] although it is quite probable that it may be found not unfrequent in the more southern portions of these States. In Texas, especially on the Rio Grande, it is a quite common bird, as it is also in Mexico and Central America. Throughout South America it is one of the most abundant species, its geographical range extending even to Cape Horn. Dr. Darwin found the *Polyborus* nowhere so common as on the grassy savannas of the La Plata, and says that it is also found on the most desert plains of Patagonia, even to the rocky and barren shores of the Pacific. It occurs also in the West Indies, especially in the island of Cuba, where it is known to breed. The eggs represented in the drawing were obtained and identified by the late Dr. Berlandier of Metamoras, in Northern Mexico, on the Rio Grande.

It is possible that two distinct species are now confounded together under the common name of Caracara Eagle. Mr. Cassin informs me that his suspicions have been excited by certain variations in specimens which have fallen under his notice, and Mr. Darwin states that he met with individuals on the plains of Santa Cruz which he and Mr. Gould were almost persuaded to be distinct species. In partial confirmation of this suspicion, I may in this connection refer to the great variations noticeable in the eggs of this vulturine Eagle. These are neither slight nor occasional, but are constant, and of so radical a character as to excite the strongest doubts of their belonging to birds of the same species, the differences affecting both their size and their ground color. The eggs from Cuba, so far as I am aware, represent one variety exclusively, those from Brazil the other, while, on the other hand, both varieties were obtained on the Rio Grande by Dr. Berlandier, who assigned them to a single species, which, in his manuscript notes, he called *Totache*. In Chile the popular name of this bird is *Traro*, but its more common title in other portions of South America is *Carrancha*.

The *Caracara* builds a coarse, flat nest, composed of flags, reeds, and grass, usually on the tops of trees, but occasionally, according to Darwin, on a low cliff, or even on a bush. The number of the eggs is rarely, if ever, more than three. Four from the Rio Grande, in my collection, exhibit the following measurements: length $2\frac{7}{16}$ inches, breadth $1\frac{14}{16}$; length $2\frac{7}{16}$, breadth $1\frac{13}{16}$; length $2\frac{5}{16}$, breadth $1\frac{14}{16}$; length $2\frac{4}{16}$, breadth $1\frac{12}{16}$. These eggs not only present the great and unusual variation in their length of nearly eight per cent (between the two extremes), but very striking and anomalous deviations from uniformity are also noticeable in their ground color and markings. The ground color varies in these specimens from a nearly pure white to a very deep russet, or tan-color, and their markings, though all of sepia-brown, differ greatly in their shades. So far as I may be justified in determining from the few specimens I have seen, the eggs with the light ground are

[1] Since writing this article, I have learned that the Smithsonian Institution possesses specimens from the Gulf coast of Louisiana, and from New Mexico and California.

uniformly the larger in size and in shape, and are somewhat more oblong. In the largest, the measurement of which is given above, the ground color is nearly pure white with a slight pinkish tinge, nearly unspotted at the smaller end, and only marked by a few light blotches of a sepia-brown. These markings increase both in size and frequency, and become of a deeper shade, as they are nearer the larger end, until they become almost black, and around this extremity they form a large confluent ring of blotches and dashes of a dark sepia. The second in size, which is but just perceptibly smaller, has a ground color of light russet, or rather white with a very slight russet tinge, and is marked over its entire surface, in about equal proportion, with irregular lines and broad dashes of dark sepia. In the third, the ground is of the deepest russet, or tan-color, and in the smallest, of the same, but of a somewhat lighter shade, and both are beautifully marked with deep blotches of a dark sepia, almost black. The eggs of this species are much more oblong than those of most birds of prey, and in this respect also show their relation to the Vultures rather than to the Hawks or Eagles. They are pyriform, the smaller end tapers quite abruptly, and varies much more, in its proportions, from the larger extremity, than the eggs of any true Hawk with which I am acquainted.

MORPHNUS UNICINCTUS.

Falco unicinctus, Temm. Pl. Col. I, 1827, 313.
" " Gay, Fauna Chilena, Aves, 1855, p. 216.
Falco harrisii, Aud. Orn. Biog. V, 1835, 30, pl. cccxcii.
" " Bonap. Geog. and Comp. List, 1838, p. 3.
Buteo harrisii, Aud. Syn. 1839, p. 5.
" " " Birds of Am. I, 1840, 25, pl. v.
Polyborus tæniurus, Tschudi, Wiegm. Archiv. X, 1844, 263.
" " " Fauna Peruana, Orn. pl. i.
Morphnus unicinctus, Cassin, Syn. N. A. Birds, 1854 (Illust. Birds of Cal.), p. 114.
" " " Birds of Gilliss's U. S. Nav. Astron. Ex. II, 1855, 174.
Vulg. — *Harris's Buzzard. Red-winged Hawk. Red-winged Buzzard. Peuco. Aquililla* (Berlandier, MSS. Mexico).

This Hawk has a very limited range within the United States. Mr. Audubon, who was the first to meet with it within the limits of the Union, obtained a single specimen in Louisiana. Supposing it to be an undescribed species, he named it in honor of his friend, Mr. Edward Harris, a distinguished naturalist of New Jersey. It had, however, been previously described by Temminck.

The Red-winged Buzzard is occasionally found in the lower portions of the States of Mississippi and Louisiana. It becomes much more abundant in the southwestern sections of the latter State, and in Texas is a very common species, especially about

the mouth of the Rio Grande. It is also frequently met with throughout Mexico, Central America, Peru, and Chile. It is an occasional visitant of Cuba and Jamaica.

In its habits this Hawk is heavy and sluggish. It frequents streams of water, and its food consists chiefly of the reptiles and smaller animals which frequent the banks of rivers and creeks. They build their nests on low trees, in the immediate vicinity of their hunting-ground, and often over the water, constructing them of coarse flags and water plants. The nests are usually not very large for the birds, are flattened or with very slight depressions, and the materials are very loosely put together. The eggs are from three to five in number, usually white and unspotted, occasionally with more or less of a yellowish or tawny tinge. In some instances they are faintly marked with light dashes or stains of a yellowish-brown, and, more rarely, are also marked with small blotches of sepia-brown, and with smaller dottings of purplish-drab. Their average measurement is, length $2\frac{2}{16}$, breadth $1\frac{1}{16}\frac{1}{6}$.

All the knowledge at present possessed in regard to the eggs of these Hawks is derived from the collection of the late Dr. Berlandier, of Metamoras, in the Province of Tamaulipas, Mexico. In the cabinet of that gentleman were several varieties, now in the possession of the Smithsonian Institution. These are shown, by the notes and private memoranda of Dr. Berlandier, who was a diligent observer of birds, to belong to this Hawk. For the preservation of this collection, the public is indebted to the timely intervention of Lieutenant Couch, by whom they were purchased, and through whose offices they were secured for the purposes of science.

Family STRIGIDÆ.

STRIGINÆ.

STRIX PRATINCOLA.

Strix flammea, Wilson, Am. Orn. VI, 1812, 57, pl. l, fig. 2.
" " Bonap. Syn. 1828, p. 38.
" " Nuttall, Manual, I, 1832, p. 139.
" " Aud. Orn. Biog. II, 1835, 403 ; V, 388 ; pl. clxxi.
Strix pratincola, Bonap. Geog. and Comp. List, 1838, p. 7.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 116.
Strix americana, Aud. Syn. 1839, p. 25.
" " " Birds of Am. I, 1840, 127, pl. xxxiv.
" " De Kay, Nat. Hist. N. Y., Birds, 1844, pl. xiii. fig. 28.
Vulg. — *The American Barn Owl. The White Owl.*

The geographical limits of the North American Barn Owl cannot be determined with precision. Some disagreement exists among naturalists as to the identity and diversity of several varieties in different parts of the world, all closely related to each other, yet specifically distinct. The *Strix flammea* of Europe is both a distinct species from the *Strix pratincola* and a smaller variety. The African is, again, probably a different bird from either. On this continent three distinct varieties, closely resembling each other, are recognized by more recent writers as different species. These are *S. perlata* of South America, *S. furcata* of Cuba, and the *S. pratincola* of North America. The last-named Owl rarely, if ever, occurs, except by accident, north of Pennsylvania, and is not common until we reach South Carolina. From there it is distributed south and west to the Pacific. It is quite common in Texas and New Mexico, and is one of the most abundant birds of California. It was not met with by Dr. Woodhouse in the expedition to the Zuñi River, but this may be attributed to the desolate character of the country through which he passed, as this Owl is chiefly found about habitations, and is never met with in wooded or wild regions.

Dr. Heermann and Dr. Gambel, whose visit to California was before the present increase in population, speak of its favorite resort as being in the neighborhood of the Missions, and of its nesting under the tiled roofs of the houses. The latter also refers to his finding numbers under one roof, and states that they showed no fear when approached. The propensity of the California bird to drink the sacred oil from the consecrated lamps about the altars of the Missions was frequently referred to by the priests, whenever any allusion was made to this Owl.

The South American variety was met with by Lieutenant Gilliss as far south as Chile, where it was of unusual occurrence. This bird is readily distinguished from the North American by its smaller size and longer legs. The Cuban bird, which is

probably also the same as that of Jamaica, is not so readily distinguished. Mr. Gosse, in his "Birds of Jamaica," regards it as identical. As that writer had several good opportunities of observing the breeding habits of the Jamaica Barn Owl, I shall adopt his account, as in all probability essentially agreeing with that of our own bird. He found the breeding-place of this Owl at the bottom of a deep limestone pit. In the middle of October there was one young bird with several eggs. There was not the least vestige of a nest; the bird reposed on a mass of half-digested hair mingled with bones. At a little distance were three eggs. They were not collected for sitting, as no one of them was within six inches of another. On the 12th of the next month he found in the same place the old bird sitting on four eggs, this time placed close together. There was still no nest. The eggs were advanced towards hatching, but in very different degrees, and an egg ready for deposition was found in the oviduct of the old bird. He speaks of these eggs as differing in no wise, except in size, from those of the common Hen. The size he does not give.

An egg taken in Louisiana by Dr. Trudeau, and of which I have an accurate drawing, measures $1\frac{1}{1}\frac{1}{6}$ inches in length, by $1\frac{3}{1}\frac{}{6}$ in breadth. Another, obtained in New Mexico, measures $1\frac{1}{1}\frac{1}{6}$ by $1\frac{4}{1}\frac{}{6}$. Its color is a dirty yellowish-white, without any spots. Its shape is an oblong oval, hardly more pointed at the smaller than at the larger end. An egg of the *Strix flammea*, from France, measures $1\frac{9}{1}\frac{}{6}$ inches by $1\frac{4}{1}\frac{}{6}$. Another, from Africa, given me as that of the Barn Owl of that region, is much larger than any of the above, measuring $1\frac{1}{1}\frac{4}{6}$ inches in length by $1\frac{6}{1}\frac{}{6}$ in breadth. The last two are undoubtedly different species from our corresponding variety.

BUBONINÆ.

BUBO VIRGINIANUS.

Strix scandiaca, Linn. Syst. Nat. I, 1766, 132. (?)
Strix virginiana, Gmelin, Syst. Nat. I, 1788, 287.
" " Wilson, Am. Orn. VI, 1812, 52.
" " Bonap. Syn. 1828, p. 37.
" " Rich. & Swains. F. B. A. II, 1831, 82.
" " Nuttall, Manual, I, 1832, 124.
" " Aud. Orn. Biog. I, 1832, 313; V. 392.
" " De Kay, Nat. Hist. N. Y., Birds, 1844, pl. x, fig. 22.
Strix pythaules, Bartram, Trav. 1791, p. 289.
Bubo ludovicianus, Daudin, Traité d'Orn. 1800, II, 210.
Bubo pinicola, Vieill. Ois. d'Am. Sept. I, 1807, 51.
Bubo arcticus? Rich. & Swains. F. B. A. II, 1831, 86, pl. xxx.
Bubo septentrionalis, Brohm, Vög. Deutschl. 1831, p. 120. (?)
Bubo virginianus, Bonap. Geog. and Comp. List, 1838, p. 6.
" " Aud. Syn. 1839, p. 29.
" " " Birds of Am. I, 1840, 143, pl. xxxix.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 177.
Bubo sub-arcticus, Hoy, Proc. Acad. Phila. VI, 1852, 211. (?)

Vulg. — *The Great Horned Owl. Cat Owl. Great Screech-Owl. Le Grand Hibou d'Amérique* (Cuvier). *The Virginian Owl. Tejolote Grande* (Berlandier MSS. Mexico).

The Great Horned Owl of North America has a very wide geographical distribution, being found abundantly from the Arctic regions to Mexico, and throughout North America, both on the Atlantic and the Pacific. Mr. Cassin considers the *arcticus* of Swainson and the *magellanicus* of Gmelin as mere varieties of this species. He does not appear to regard it as being a South American bird, where the *B. crassirostris* has probably been mistaken for this species. Sir John Richardson speaks of it as not uncommon in the Arctic regions. It is abundant in Canada, and throughout all parts of the United States. Dr. Gambel met with it also in large numbers in the wooded regions of Upper California. Dr. Heermann found it very abundant around Sacramento in 1849, but since the increase in population it has become comparatively rare. Dr. Woodhouse met with it in the Indian Territory, though not abundantly. Lieutenant Couch obtained specimens in Mexico, and Mr. Schott in Texas.

This Owl usually breeds in the more unsettled and wooded parts of the country. For the most part, it constructs for itself a large nest, composed of dry sticks, lined with leaves and a few feathers. Mr. Audubon also states that he has found nests belonging to the Great Horned Owl in large hollows of decayed trees, and twice in the fissures of rocks. In all these cases, little preparation had been made previous to the laying of the eggs, as the nest consisted of only a few grasses and feathers. I have never heard of instances of a construction of the nests in this manner, but in all cases that have come under my observation this Owl has built for itself a large and somewhat elaborate nest. Wilson, who found them breeding in the swamps of

New Jersey, states that the nest was generally constructed in the fork of a tall tree, but adds that they sometimes choose a smaller tree.

These birds begin to construct their nest towards the close of winter, and, even in the Arctic regions, Sir John Richardson speaks of their hatching their eggs as early as March. The shape of the egg is very nearly exactly spherical, and its color is a dull white with a slightly yellowish tinge. An egg formerly in the old Peale's Museum of Philadelphia, taken in New Jersey by Alexander Wilson, the ornithologist, and bearing his autograph upon its shell, measures $2\frac{5}{16}$ inches in length by 2 in breadth. Another, obtained in the vicinity of Salem, Mass., measures $2\frac{4}{16}$ inches in length by $1\frac{14}{16}$ in breadth. In the latter instance the nest was constructed on a tall and inaccessible tree, in a somewhat exposed locality. The female was shot on the nest, and as she fell, she clutched one of the eggs in a convulsive grasp, and brought it in her claws to the ground. Mr. Cassin states that the southern varieties are also different in their size, being smaller than the more northern. This is true also of their eggs. One obtained in Tamaulipas, Mexico, near the Rio Grande, measures $2\frac{3}{16}$ inches in length by $1\frac{13}{16}$ in breadth. This egg is one of the Berlandier collection, now in the possession of the Smithsonian Institution, and is the one represented in the plate (Plate IV, fig. 39).

SCOPS ASIO.

Strix asio, Linn. Syst. Nat. I, 1766, 132.
" " Wilson, Am. Orn. V, 1812, 83, pl. xlii, fig. 1.
" " Bonap. Syn. 1828, p. 36.
" " Aud. Orn. Biog. I, 1832, 486; V, 392; pl. xcvii.
" " Nuttall, Manual, I, 1832, 120.
Strix nævia, Gmelin, Syst. Nat. I, 1788, 289.
" " Wilson, Am. Orn. III, 1812, 16, pl. xix. fig. 1.
Bubo striatus, Vieill. Ois d'Am. Sept. I, 1807, 54, pl. 21.
Scops asio, Bonap. Geog. and Comp. List, 1838, p. 6.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 179.
Bubo asio, Aud. Syn. 1839, p. 29.
" " " Birds of Am. I, 1840, 147, pl. xl.
" " De Kay, Nat. Hist. New York, 1844, pl. xii, figs. 25 and 26.
Hibou asio, Temm. Pl. Col. pl. lxxx.
Vulg. — *The Mottled Owl. The Red Owl. Little Screech-Owl. Little Owl. Screech-Owl. Little Cat-Owl.*

The little Red or Mottled Owl is a very widely distributed bird. It is found in Greenland, and probably in all parts of North America. Sir John Richardson did not, however, meet with it in the Arctic regions. It is much more abundant in some parts of the continent than in others. It is quite common throughout New England, as well as in the Middle and some of the Southern States. Mr. Audubon

speaks of it as not common in Louisiana, although occasionally found there. Dr. Hall mentions it as abundant in the vicinity of Montreal. It is also said to be frequently met with in Ohio, Minnesota, and Oregon. Dr. Heermann mentions it as not rare in California, although Dr. Gambel does not appear to have met with it in his investigations in that quarter. Dr. Woodhouse, in his report of the expedition to the Zuñi River, speaks of finding this noisy little Owl very abundant throughout the Indian Territory, but adds that he did not meet with it so frequently in Texas.

The nest of this species is always constructed in hollow trees or stumps, most frequently in orchards in the vicinity of farm-houses, and not more than six or seven feet from the ground. Mr. Audubon states, however, that he has sometimes found them at the height of thirty or forty. Mr. Nuttall gives some interesting facts showing the provident habits of this Owl in procuring for its young a great superabundance of food. He found in the nest of a single pair, in the hollow stump of an apple-tree, which contained a brood of these young Owls, several Bluebirds, Blackbirds, and Song-Sparrows.

The Screech-Owl can hardly be said to construct any nest, but lines the hollow in which it rears its young with a few loose leaves, dry grasses, and feathers. The eggs are usually five or six in number, are pure white, and nearly round. Their average measurement is $1\frac{6}{16}$ inches in length by $1\frac{3}{16}$ in breadth.

SCOPS McCALLII.

Ephialtes choliba, Lawrence, Annals of New York Lyceum of Nat. Hist. VI, 1853, 4.
Scops McCallii, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 180.
Vulg. — *The Western Mottled Owl. McCall's Mottled Owl. Tejolote* (Berlandier).

This is a new species recently described by Mr. Cassin, and little is as yet known as to the extent of its geographical distribution. The first specimen of this Owl ever obtained was taken by E. S. Holden, Esq. near Sacramento, and described by George S. Lawrence, Esq. of New York, as *Ephialtes choliba*, Vieill. (*Strix crucigera*, Spix). It was found in Texas by Mr. Schott, and in Northern Mexico by Lieutenant Couch. It also occurs in the collection of Dr. Berlandier, now in the possession of the Smithsonian Institution, and was obtained in the Province of Tamaulipas in Eastern Mexico. An egg in the same collection, of this species, measures $1\frac{2}{16}$ inches in length by $\frac{15}{16}$ of an inch in breadth. Its shape is nearly that of a sphere, and the color is a clear crystal-white.

OTUS WILSONIANUS.

Strix americana, Gmelin, Syst. Nat. I, 1788, 288.
" " Bonap. Cons. Avium, p. 50.
Strix peregrinator, Bartram, Trav. 1791, p. 289.
Strix otus, Wilson, Am. Orn. VI, 1812, 52.
" " Bonap. Syn. 1829, p. 37.
" " Nuttall, Manual, I, 1832, 130.
" " Aud. Orn. Biog. IV, 1835, 573, pl. ccclxxxiii.
Otus wilsonianus, Lesson, Traité d'Orn. I, 1831, 110.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1851, p. 181.
Otus americanus, Bonap. Geog. and Comp. List, 1838, p. 7.
Otus vulgaris, Aud. Syn. 1839, p. 28.
" " " Birds of Am. I, 1840, 136, pl. xxxvi.
Vulg. — *The Long-eared Owl. American Long-eared Owl. The Prairie Owl.*

This is a Northern and Eastern species, and does not appear to have been met with on the western coast south of Oregon. At least, neither Dr. Gambel nor Dr. Heermann observed the present species in California, although Dr. Cooper obtained specimens in Washington Territory and Dr. Townsend in Oregon. Its supposed absence, however, from that State may be an error, as, owing to its strictly nocturnal habits, it is not readily procured, and may in consequence have been overlooked. Sir John Richardson found this Owl as far to the north as latitude 60°, and thinks that its range probably extends to the extreme limits of the forests. It breeds on the eastern coast, from the Arctic regions to New Jersey, but is rarely found south of that State. On the Pacific its limits are as yet not well defined. It is said to be plentiful on the Saskatchewan, but its abundance elsewhere is rather inferred than actually known. Appearing rarely in the daytime, it is not very frequently met with by naturalists. According to Sir John Richardson, in the fur regions it sometimes lays its eggs on the ground, at other times in the deserted nests of other birds, on low bushes. Mr. Hutchins speaks of its depositing them as early as April. Richardson received one found in May, and another nest was observed, in the same neighborhood, which contained three eggs on the 5th of July. Wilson speaks of this Owl as having been abundant in his day in the vicinity of Philadelphia, and of six or seven having been found in a single tree. He also mentions it as there breeding among the branches of tall trees, and in one particular instance the Long-eared Owl had taken possession of the nest of a Qua Bird (*Ardea nycticorax*), where Wilson found it sitting on four eggs, while one of the Herons had her own nest on the same tree.

Audubon states that the American Long-eared Owl usually accommodates itself by making use of the abandoned nests of other birds, whether these are built high or low. It also makes use of the fissures of rocks, or builds on the ground. He also states that it sometimes constructs a nest of its own. He found one near the Juniata River, in Pennsylvania, composed of green twigs with the leaflets adhering, and lined with fresh grass and sheep's wool, but without feathers. In the summer of

1856 I received from Robert Kinnicott, Esq., of Cook County, Illinois, an Owl's egg found by a boy on the ground, in a prairie. It was sent to me as probably an egg of the Short-eared Owl, but from its close resemblance to all the eggs of the *Otus wilsonianus* I have ever seen, and its dissimilarity from those of the *Brachyotus cassinii*, I have no doubt that it was an egg of the former.

As this species is variously spoken of as breeding in April and in July, it probably raises more than one brood in a season. The eggs are usually four in number, are nearly round, and of a uniform dull-white color. One from New Jersey, obtained by Mr. Alexander Wilson, measures $1\frac{7}{16}$ inches in length, by $1\frac{5}{16}$ in breadth.

BRACHYOTUS CASSINII.

Strix brachyotus, Forster, Philos. Trans. London, 1772, LXII, 384.
" " Wilson, Am. Orn. IV, 1812, 64, pl. xxxiii, fig. 3.
" " Bonap. Syn. 1828, p. 37.
" " Rich. & Swains. F. B. A. II, 1831, 75.
" " Nuttall, Manual, I, 1832, 132.
" " Aud. Orn. Biog. V, 1835, 373, pl. 432.
Brachyotus palustris (*americanus*), Bonap. Geog. and Comp. List, 1838, p. 7.
" " " " Cons. Av. p. 51.
Otus brachyotus, Aud. Syn. 1839, p. 28.
" " " Birds of Am. I, 1840, 140, pl. xxxviii.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 182.
Brachyotus cassinii, Brewer, Proceedings Boston Nat. Hist. Soc., Feb. 1856.
Vulg. — *Short-eared Owl. American Short-cared Owl. Cassin's Short-eared Owl.*

So long as the Short-cared Owl of North America was supposed to be identical with the *Brachyotus palustris* of Europe, and its representative variety in South America, it was permitted to lay claim to the widest geographical range of any bird known to us. With this supposition of its identity, we should have to assign to it, as its habitat, a very large portion of the globe, embracing the whole American continent, from its most northern point — inclusive of Greenland — to some of the most extreme southwestern portions of South America, together with all the northern and temperate portions of the Eastern continent. The grave doubts which have long existed as to its right to this claim of identity with either the European or the South American bird may now be regarded as having become certainties, and our American species must be received as separate and distinct, though closely allied. From the European it is certainly quite different. From the South American it differs in a less degree, yet still presents certain constant deviations, hardly less than specific.

The Short-cared Owl of our Southern continent has been obtained as far to the

south as the Straits of Magellan.[1] Lieutenant Gilliss brought home quite a number from Chile,[2] and Mr. Gould has received specimens from Brazil.[1] Two of these birds are also said to have been brought from the Sandwich Islands.[1] I cannot, however, find that this variety has ever been found to have a more northern range than the central regions of South America.

The North American bird is larger, and for the most part of a darker color, than the European Owl. This is especially true of the female. As the differences between these varieties are constant, and are as well marked as in many other instances where the birds are now acknowledged to be distinct species, there is no good reason why they should be regarded as identical. If we assume Mr. Gould's genus of *Brachyotus* to be a good one, it leaves our own immediate species with no specific name, and I have been able to find none more appropriate or deserved than one giving to it an association with the name of the naturalist who first pointed out the specific differences between these species. I have therefore named it in honor of my esteemed friend, Mr. Cassin, of Philadelphia, a gentleman who stands confessedly in the first rank of American ornithologists, and who, in patient and diligent research, and in skilful and discriminating investigations into the intricate problems of Natural History, has no superior among her votaries.

The South American variety (*Brachyotus galapagoensis*, Gould) more closely resembles the *B. cassinii*, and is not readily distinguished from it. It is, however, without any doubt, a quite distinct species, though the points of specific difference cannot at present be very clearly pointed out. The most noticeable is the constantly deeper shade of fulvous in the South American bird. Another circumstance which, as it seems to me, should have no small weight in determining the question, is, that so long an interval of territory exists between the several habitats of these species, in which neither occurs. Latitude 40° north on the Atlantic coast, and about 38° on the Pacific, is believed to be the southern limit of the range of the Northern species, and somewhere about 20° south the northern line of the South American variety.

Having thus assumed the Short-eared Owl of North America to be a distinct species from either the European or the South American variety, I must claim for it much more restricted limits than have generally been assigned, yet still a range quite as extended as that of any of this family. Sir John Richardson met with it as far to the north as latitude 67°. Professor Holboll gave it as a bird of Greenland. Dr. Cooper has obtained specimens in Oregon, and Dr. Heermann speaks of it as common in California, though Dr. Gambel, a very diligent and observing naturalist, met with no specimens there.[3] In the United States, there are no well-authenticated instances of its having been noticed south of Pennsylvania, though both Dr. Gundlach and Mr. Lembeye mention this Owl as an occasional visitant of Cuba. Dr.

[1] Yarrell's British Birds, I, 125.

[2] The U. S. Naval Astronomical Expedition to the Southern Hemisphere, II, 177.

[3] Since the above was written, and while these pages are passing through the press, an undoubted specimen of the *Brachyotus cassinii* has been received from California. It was obtained in February (1856), near Petaluma, by Mr. Emanuel Samuels, and accompanied the collection made by him of the natural history of that region for the Smithsonian Institution and the Boston Society of Natural History.

Woodhouse did not observe this bird in the expedition to the Zuñi River, nor am I aware that it has ever been obtained in any of our Southern or Southwestern States.

Very little is known in regard to the habits of these varieties, and not enough to have much influence in determining the question of their non-identity. According to the observations of Sir John Richardson, the principal haunts of the American are dense thickets of young pine-trees, or dark and entangled willow-clumps, where it sits on a low branch watching assiduously for mice. When disturbed, it flies for a short distance, and then hides itself in the heart of a bush, whence it is not easily driven.

On the other hand, we learn that the European bird, unlike the short-eared species of North America, which thus hides itself in large woods or dense plantations, "frequents wide, open fields, extensive commons, heaths, and moors." In the Orkney Islands, the European Owl "forms an artless nest among the heath." Sir William Jardine, describing two nests of that Owl which he met with in Dumfriesshire, says: "They were formed upon the ground, among the heath, the bottom of the nest scraped until the fresh earth appeared, on which the eggs were placed without any lining or other accessory covering."

According to Dr. Richardson, the American species forms a nest of withered grass and moss, placed on a dry spot of ground. Mr. Audubon, the only other naturalist who has described the nest of this bird, speaks of having once met with one on a high ridge in the Great Pine Forest of Pennsylvania. The nest contained four eggs nearly ready to be hatched. He describes them as dull bluish-white, of a somewhat elongated or elliptical form, measuring an inch and a half in length, and an inch and an eighth in breadth. This nest was found on the 17th of June, was placed under a low bush, and covered over by tall grass, raked together in a slovenly manner, and quite flat. I have in my possession a copy of the drawing made by Mr. Audubon, which was probably a sketch hastily taken by him on the spot. The drawing is however a little larger than the measurements in his description represent the eggs to have been.

Another specimen of the eggs of this bird, from Hudson's Bay, in my collection, is more elongated than is usual in an Owl's egg, is of a dull-white color, with no apparent shade of blue, and measures $1\frac{9}{16}$ inches in length by $1\frac{4}{16}$ in breadth.

The egg represented in the plate was obtained by my friend, Eliot Cabot, Esq., on an island in the Bay of Fundy, and by him well identified. Its shape is also much more oblong than is usual in birds of this family. It is in form an elliptical ovoid, in color a uniform dull-white, and its measurements correspond exactly with the specimen from Hudson's Bay above referred to. Dr. Henry Bryant, who accompanied Mr. Cabot in the visit to the Bay of Fundy, has furnished the following in addition: "A nest of this bird was found by Mr. Cabot in the midst of a dry peaty bog. It was built on the ground, in a very slovenly manner, of small sticks and a few feathers, and presented hardly any excavation. It contained four eggs on the point of being hatched. A young bird the size of a robin was also found lying dead on a tussock of grass in another similar locality."[1]

[1] Proceedings of Boston Natural History Society, January, 1857.

SYRNINÆ.

SYRNIUM CINEREUM.

Strix cinerea, Gmelin, Syst. Nat. I, 1788, 291.
" " Rich. & Swains. F. B. A. II, 1831, 77.
" " Aud. Orn. Biog. I, 1832, 364; pl. cccli.
" " Nuttall, Manual, I, 1832, 128.
Strix lapponica, Retzius, Faun. Suec. 1800, p. 79.
Strix fuliginosa, Shaw, Gen. Zoöl. VII, 1809, 244.
Strix barbata, Pallas, Zoöl. Ross. I, 1811, 318.
Syrnium cinereum, Gould, Birds of Europe, I, 1832, pl. xlii.
" " Bonap. Geog. and Comp. List, 1838, p. 6.
" " Aud. Syn. 1839, p. 1839.
" " " Birds of Am. I, 1840, 130, pl. xxxv.
" " De Kay, Nat. Hist. N. Y. 1844, pl. xiii, fig. 29.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 184.
Vulg. — *The Great Gray Owl. The Cinereous Owl. The Great Cinereous Owl.*

The Cinereous Owl is confined to the more northern portions of Europe, Asia, and America, and is very rarely met with even in the extreme northern portions of the United States, and then only in midwinter. Its farthest southern limit on the Atlantic, so far as known, is Massachusetts, where only two or three instances of its occurrence are on record; and on the Pacific, the Territory of Oregon, where it was met with by Dr. Townsend. In Europe it is even more exclusively Arctic than on this continent. Lapland and Iceland are the only localities indicated by Temminck, and even there it is spoken of as quite rare. Mr. Temminck also received two specimens taken in Greenland. Its presence in Northern Asia is rather inferred than really known.

Our only positive knowledge of its nest is furnished by Richardson, who also states that it is by no means a rare bird in the fur countries, and that it is an inhabitant of all the woody districts between Lake Superior and latitude 68°, and between Hudson's Bay and the Pacific. He discovered the nest in question on the 23d of May, on the top of a lofty balsam-poplar. It was composed of sticks and lined with feathers, and contained young.

Having no specimen of the egg, I am unable to illustrate it. I have, however, in my possession a drawing of an egg of this Owl, sketched by Mr. Audubon from a specimen from the fur regions, and afterwards again copied by Dr. James Trudeau. I have no reason to doubt its authenticity. This specimen was of a clear, but not a bright, white color, was nearly spherical, and measured $2\frac{7}{16}$ inches in length by exactly 2 in its greatest breadth.

SYRNIUM NEBULOSUM.

Strix nebulosa, Forster, Trans. Philos. Soc. London, LXII, 1772, 386 and 424.
" " Wils. Am. Orn. Biog. IV, 1812, 61, pl. xxxiii, fig. 2.
" " Bonap. Syn. 1828, p. 38.
" " Rich. & Swains. F. B. A. II, 1831, 81.
" " Nuttall, Manual, I, 1832, 133.
" " Aud. Orn. Biog. I, 1832, 242; V, 386, pl. xlvi.
" " De Kay, Nat. Hist. N. Y. 1844, pl. x, fig. 21.
Strix chichictli, Gmelin, Syst. Nat. I, 1788, 296.
Strix acclamator, Bartram, Trav. 1791, p. 289.
Strix varius, Bartram, Mss. Frag. Nat. Hist. Penn. 1799, p. 11.
Strix fernandica, Shaw, Gen. Zoöl. VII, 1809, 263.
Ulula nebulosa, Bonap. Geog. and Comp. List, 1838, p. 7.
Syrnium nebulosum, Gould, Birds of Europe, I, 1832, pl. xlvi.
" " Aud. Syn. 1839, p. 27.
" " " Birds of Am. I, 1840.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 184.

Vulg. — *The Barred Owl. The Whooting Owl* (Bartram). *La Chouette du Canada* (Cuvier). *Chouette Nebuleuse* (Temm.).

The Barred Owl has an extended range, having been met with nearly throughout North America. It is distributed from the fur regions to Texas. Minnesota is the most western point to which, so far as I am aware, it has been traced. It is more abundant in the Southern States than elsewhere, and in the more northern portions of North America is somewhat rare. Richardson did not encounter it in the more Arctic portion of the fur countries, nor has it, so far as I can learn, been observed on the Pacific. In Europe, it is of accidental occurrence in the northern parts. In Louisiana, as Mr. Audubon states, it is more abundant than anywhere else, and Dr. Woodhouse speaks of it as very common in the Indian Territories, and also in Texas and New Mexico, especially in the timbered lands bordering the streams and ponds of that region. In July, 1846, while in pursuit of shore birds in the island of Muskeget, near Nantucket, in the middle of a bright day, I was surprised by meeting one of these birds, who, uninvited, joined us in the hunt. My companion soon arrested his course. He proved to be a fine male adult specimen.

I have never met with the nest of this bird, but Mr. Wilson describes one found in the crotch of a white oak, among thick foliage, as rudely put together, composed outwardly of sticks intermingled with some dry grass and leaves, and lined with smaller twigs. Mr. Audubon speaks of them as breeding in the hollows of trees, and at other times as taking possession of the old nest of a Crow or Hawk. The latter also states that they breed early in March. The last statement is to some extent confirmed by the fact, that, in two instances, in the month of February a fully developed egg has been taken from the oviduct of the female. One of these cases occurred near Niagara Falls in the spring of 1852. The other, in 1854, was noticed by Professor William Hopkins, then of Auburn, N. Y., to whose kindness I am indebted for the egg the parentage of which is so unquestionable. It is purely white,

almost globular, and, except in shape, hardly distinguishable from the egg of the domestic Hen. It is two inches in length, $1\frac{1}{16}$ in breadth.

NYCTALE RICHARDSONI.

Strix tengmalmi, Rich. & Swains. F. B. A. II, 1831, 94, pl. xxxii.
" " Aud. Orn. Biog. IV, 1835, 559, pl. ccclxxx.
Nyctale richardsoni, Bonap. Geog. and Comp. List, 1838, p. 7.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 185.
Ulula tengmalmi, Aud. Syn. 1839, p. 24.
" " " Birds of Am. I, 1840, 122, pl. xxxii.
Vulg. — *Richardson's Owl.* "*Tengmalm's Owl*" (Richardson and Swainson, Audubon, &c., incorrectly).

This Owl is an exclusively Northern bird, peculiar to North America, and rarely met with in the limits of the United States. A single specimen has been obtained in Massachusetts. Dr. Hoy mentions it as a bird of Wisconsin, and on the Pacific Dr. Townsend met with it as far south as Oregon, where it is more abundant than on the eastern coast. According to Richardson, it inhabits all the wooded country from Great Slave Lake to the United States, and is very common on the banks of the Saskatchewan. It was obtained in Canada by the Countess of Dalhousie, but at what season the bird was met with is not stated; the Smithsonian Institution also possess specimens from the vicinity of Montreal. It probably does not breed so far south as that place, or, if so, very rarely. Mr. Audubon procured a specimen near Bangor in Maine, in September, the only one he ever met with.

This Owl, according to Mr. Hutchins, builds a nest of grass, half-way up a pine-tree, and lays two eggs in the month of May.

I have in my possession the copy, made by Dr. James Trudeau, of a drawing taken by Mr. Audubon from a specimen in an English cabinet. It is nearly spherical, the color white with a slight tinge of yellowish, and measures $1\frac{3}{16}$ inches in length by one inch in breadth.

As I have no means of access to any authenticated egg of this Owl, I am unable to illustrate it, though it probably would not be distinguishable from that of Tengmalm's Owl, to which it is so closely allied.

NYCTALE ACADICA.

Strix acadica, Gmelin, Syst. Nat. I, 1788, 296.
" " Bonap. Syn. 1828, p. 38.
" " Rich. & Swains. F. B. A. II, 1831, 97.
" " Nuttall, Manual, I, 1832, 137.
" " Aud. Orn. Biog. II, 1835, 567; V, 397; pl. cxcix.
" " De Kay, Nat. Hist. N. Y. 1844, pl. xi, fig. 23.
Strix acadiensis, Latham, Ind. Orn. I, 1790, 65.
Strix passerina, Wilson, Am. Orn. IV, 1812, 61, pl. xxxiv, fig. 1.
Nyctale acadica, Bonap. Geog. and Comp. List, 1838, p. 7.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 186.
Ulula acadica, Aud. Syn. 1839, p. 24.
" " " Birds of Am. I, 1840, 123, pl. xxxiii.
Vulg. — *The Acadian Owl. The Little Owl. The Saw-Whet. American Sparrow-Owl.*

The Saw-Whet Owl, as this bird is often called, seems to be distributed throughout nearly all North America, but with some degree of irregularity. Although not observed by Sir John Richardson in the Arctic regions, it has been obtained as far north as New Caledonia. Dr. Townsend observed it in Oregon, Dr. Gambel in California, Mr. Audubon in Kentucky and Louisiana, Wilson in New Jersey, McCullock in Nova Scotia, and Dr. Hoy in Wisconsin. I have an egg from Northern Ohio, and have also observed the bird in various parts of New England. Its nocturnal and secluded habits withdraw it from general observation, so that it is quite possible that this species is a very common one, even where its very existence has been unknown. The Acadian Owls rear their young in the hollows of trees, often only a few feet from the ground, in the deserted nests of other birds, in the crevices of rocks, and, according to Wilson, occasionally construct nests for themselves among thick pine-trees. The eggs are nearly spherical, are of a bright clear white, and more like a Woodpecker's than an Owl's in their crystalline clearness. A specimen from Northern Ohio measures $1\frac{2}{16}$ inches by $\frac{14}{16}$.

ATHENINÆ.

ATHENE HYPUGŒA.

Strix cunicularia, Say, Long's Expedition, I, 1819, 200.
" " Bonap. Am. Orn. I, 1825, 68.
" " Nuttall, Manual, I, 1832, 118.
" " Aud. Orn. Biog. V, 1835, 264, pl. ccccxxxii, fig. 1.
Strix hypugæa, Bonap. Am. Orn. I, 1825, 72.
Athene cunicularia, Bonap. Geog. and Comp. List, 1838, p. 6.
Surnia cunicularia, Aud. Syn. 1839, p. 23.
" " " Birds of Am. I, 1840, 119, pl. xxi. ?
Athene socialis, Gambel, Proc. Acad. Phil. III, 1852, 47.
Athene hypugæa, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 188.
Vulg. — *The Burrowing Owl.*

The Burrowing Owl of North America has been ascertained to be a distinct species from the *Athene cunicularia* of South America, with which it was confounded by Audubon, and, since the publication of his Ornithology, by other writers. The *cunicularia* closely resembles the Northern species, as well as several other South American varieties, from which, however, it is specifically different. In Western North America, especially in Oregon and California, as well as in Nebraska, Kansas, Arkansas, Utah, Texas, and New Mexico, this Owl is very abundant in certain localities, where the birds live together in large communities, and differ from most members of this family by living and breeding in burrows in the ground. As the habits of this species in this respect are peculiar and interesting, and as I have never had an opportunity to observe them in their native haunts, in order to present a full account of their peculiarities I must avail myself of the observations of others.

Mr. Thomas Say was the first of American naturalists to add this bird to our fauna. He met with it in Colonel Long's expedition to the Rocky Mountains. He encountered them in our trans-Mississippian territories, where he described them as residing exclusively in the villages of the Prairie Dog, whose excavations are so commodious as to make it unnecessary for the bird to dig for itself, which, however, it is able to do when occasion requires. Mr. Say states that these villages are very numerous, and variable in their extent, sometimes covering only a few acres, and at others spreading over the surface of the country for miles together. They are composed of slightly elevated mounds, having the form of a truncated cone, about two feet in width at base, and seldom rising as high as eighteen inches above the surface. The entrance is at the top or on the side. From the entrance the passage descends vertically one or two feet, and thence it continues obliquely downward until it terminates in the snug apartment where the Marmot enjoys its winter's sleep, and where it and the Owl are common, but unfriendly occupants.

Dr. Townsend states that in the plains near the Columbia River this Owl resorts to the forsaken burrows of the marmots and the badgers, but never lives on terms of intimacy with either. The nest he describes as of fine grass, and placed at the

extremity of the hole. The eggs are uniformly four in number, pale white, and about the size of those of the common House Pigeon, the great end, however, being remarkably large, and tapering abruptly.

Dr. Heermann's account, describing individuals met with in California, differs somewhat from the above. He speaks of the nest as composed of a few straws placed at the end of a winding burrow, varying from four to ten feet in length, and the eggs as four in number, pure white, and nearly spherical. Dr. Gambel, who also observed this bird in California, states that he has occasionally found the bird in solitary burrows, and also that it often makes use of the holes dug by the large ground-squirrel (*Spermophilus beecheyi*), which is there a very common species. The Owls often dig their own burrows, and live in scattered companies of four or five. Dr. Gambel also states that the bird is a resident of California throughout the year. Dr. Woodhouse found it abundant west of the Arkansas River, and noticed that, though he often found the Owl and Marmot together, he also frequently met with them separately, the Marmots where there was apparently no water, the Owls always in the vicinity of water. He frequently found the latter in villages by themselves. On being approached, they commenced chattering and bowing, presenting quite a ludicrous appearance.

Mr. Darwin, in the Zoölogy of the Beagle, met with the *A. cunicularia*, a larger species, in crossing the Pampas of South America. In Banda Oriental, he says, it is its own workman, and excavates its burrows on any level spot of sandy soil, but in the Pampas, or wherever the Bizcacha is found, it uses those made by that animal. This bird, he states, preys on mice and reptiles, the North American bird on insects. Lieutenant Gilliss gives a similar account of it, from observations made in Chile. The egg of this Owl is slightly oblong and somewhat more pointed at one end, differing in this from the eggs of most Owls. It measures $1\frac{6}{16}$ inches in length by $1\frac{2}{16}$ in breadth. Its color is clear and uniform white.

Since the above was prepared, my esteemed young friend, Mr. Nathaniel H. Bishop, of Medford, Mass., has kindly furnished me with the following interesting account of his observations on the habits of the *A. cunicularia*. They were made by him during his adventurous journey across the Pampas of South America. Although the *cunicularia* is not a North American bird, his notes are appropriate here as affording an interesting comparison between the habits of two very closely allied species.

"I first met with the bird on the banks of the river San Juan, in Banda Oriental, one hundred and twenty miles west of Montevideo, where a few pairs were seen, devouring mice and insects. From the San Juan, travelling westward, thirty miles, I did not meet with a single individual; but after crossing the River Las Vacas, and coming upon a sandy waste covered with scattered trees and low bushes, I again met with several.

"Upon the Pampas of the Argentine Republic they are found in great numbers, from a few miles west of Rosario, which lies on the Parana, in latitude 32° 56′ south, long. 60° 32′ west, to the vicinity of San Luis, where the Pampas end and the Travesia or desert commences. On these immense plains of grass it lives in company

with the Bizcacha (*Lagostomus trichodactylus*), an animal that bears resemblance to the rabbit and agouti, and undermines a great extent of country with its burrows. This Owl is similar to that which inhabits the holes of the marmots upon the prairies of Western North America. A writer, speaking of the habits of that variety, remarks: 'We have no evidence that the Owl and Marmot habitually resort to one burrow'; and Say adds, that they were either common though unfriendly residents of the same habitation, or that our Owl was the sole occupant of a burrow acquired by the right of conquest. In this respect they differ from their South American brothers, who live in perfect harmony with the Bizcacha, and during the day, while the latter is sleeping, a pair of Owls stand a few inches within the main entrance of the burrow, and at the first sound, be it near or distant, they leave their station and remain outside the hole, or upon the mound that forms the roof of their domicile. When man approaches, both birds mount above him in the air, and keep up an alarm-note, with their irides dilated, until he passes. Then they quietly settle down in the grass, or return to their former place. On the Pampas I did not observe these birds taking their prey during the daytime, but as soon as the sun had set, the Bizcacha and Owls leave their holes, in search of food, the young of the former playing about the birds as they alight near them. They do not associate in companies, there being but one pair to a hole. Each couple keeps separate from their neighbors, and at night do not stray from their homes.

"In North America this species suddenly disappears in the early part of August, and, the Indians say, returns into its burrow and spends the winter in a torpid state, and also it is 'strictly diurnal.' In South America, it has not these habits; it does not disappear for a season, and it is both diurnal and nocturnal, for in Banda Oriental and the province of San Juan I have seen it feed at all hours. At longitude 66° west, our company struck the Travesia, and during fourteen days' travel on foot I did not see a dozen of these birds. But while residing outside the town of San Juan, which lies upon the eastern base of the Andes, one hundred and fifty miles north of Mendoza, I had a fine opportunity to watch their habits in a locality differing entirely from the Pampas. The country around San Juan is a dreary desert, covered with low thorn-trees, and over this waste a few Owls are found, principally near the town itself, in the vicinity of the pastures that are cultivated by irrigation. The months of September and October are the conjugal ones. One evening I was attracted by a strange sound that I supposed proceeded from a frog, but it proved to be the love-note of a little *Athene cunicularia*, and which was answered by his mate. The little fellow alighted upon a post and commenced turning around upon it, with throat dilated and emitting a guttural sound. These antics were continued for more than a minute, he occasionally bowing his head in a mysterious manner, which reminded us of an old male Pigeon of our dove-cots. The female soon after joined him, and they flew away. Each night he perched himself upon a tall flagstaff and uttered his love-note. Close by the house was a lagoon, the borders of which were swampy, and over this a pair often hovered in search of food. I watched one that kept on the wing for nearly two hours, some fifty feet from the ground, and during that time did not change his position in any other way than by rising

or falling a few feet. During the middle of September I had given me a male bird with a broken wing. He lived in confinement two days, and died from the effects of the wound. Soon after, a boy brought me a female with five eggs that had been taken from a burrow, five feet from the mouth. The burrow wound among the roots of a tree beneath which it was dug. The bird was very fierce on her cage, and fought me with her wings and beak, uttering all the while a long shrill note, resembling a file drawn across the teeth of a saw. I supplied her with eleven full-grown mice, which she devoured during the first thirty-six hours of her confinement. In San Juan and Banda Oriental, they do not *hover* for prey in the day-time, but watch from the top of some low trees, and do not perch on the fruit-trees, such as the orange, fig, olive, &c.

"My object was to discover if this bird burrowed its own habitation, and my observations of eight months failed to impress me with that belief. I have conversed with intelligent persons who have been familiar with their habits, and never did I find one that believed it to be its own workman. It places a small nest of feathers at the end of the hole, in which are deposited five white eggs, though Nuttall mentions that this bird in North America lays but two.

"In Banda Oriental, where the country is as fine and food far more plenty than upon the Pampas, this Owl is not common compared with the latter locality. The reason is obvious. The Bizcacha does not exist north of the Plata, and consequently these birds have a poor chance for finding habitations.

"For thirty miles beyond the San Juan River, in Banda Oriental, the ground was covered with dead beetles and other insects, the food of this bird; but I did not meet a single Owl during that day's journey. On the Pampas, where thousands upon thousands of Bizcachas undermine the soil, there in their true locality you find the same number of Owls. About San Juan (not the river), at the foot of the Andes, where a Bizcacha is rarely met with, we find only a few pairs; and does the hole dug among the roots of a tree appear to be the work of a bird or animal?

"Of this Owl in North America, Audubon says it lives in the excavations of the marmots, and *does not dig for himself*, as he is said to do in other parts of the world where no burrowing animals exist. The several works that I have consulted do not in one instance state the manner in which these Owls work when digging out a habitation, though all agree that it does burrow. Why could not some of these gentlemen state the result of the observations regarding this particular fact? Perhaps at some distant day some lucky ornithologist may catch a little fellow at work, and by reporting his evidence will upset my views upon the subject."

GLAUCIDIUM INFUSCATUM.

Strix infuscata, Temm. Manual d'Orn. I, 1820, 97.
Glaucidium gnoma, Wagler, Isis, XXV, 1832, 275.
Strix passerinoides, Aud. Orn. Biog. V, 1835, 271, pl. ccccxxxii, figs. 4, 5.
" " " Syn. 1839, p. 23.
" " " Birds of Am. I, 1840, 117, pl. xxx.
Glaucidium infuscatum, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 189.
Vulg. — *Little Columbian Owl. The Pigmy Owl. Chevechc Chevechoide* (Temm).

Little is known in regard to the habits of this, the smallest of American Owls. It was first obtained by Dr. Townsend on the Columbia River, near Fort Vancouver, and subsequently by Dr. Gairdner near the same locality. Drs. Cooper and Suckley also found it in various portions of Washington Territory. Mr. Bell and Dr. Heermann have since observed it in California, where the latter met with four birds, three of which he obtained in the daytime on trees bordering the Calaveras River. They were gentle, unsuspicious, and easily approached, and their stomachs were filled with crickets. I have a drawing of an egg of this bird, taken by Dr. James Trudeau, but where the egg was obtained from which it was drawn, or how or where it nests, I am unable to state. The egg is of a clear crystal white. Its shape is nearly exactly spherical. Its measurements are $1\frac{1}{16}$ inches in length by one inch in breadth. I am as yet unable to illustrate its egg.

NICTEININÆ.

NYCTEA NIVEA.

Strix nyctea, Linn. Syst. Nat. I, 1766, 132.
" " Wils. Am. Orn. IV, 1812, 53, pl. xxxii, fig. 1.
" " Bonap. Syn. 1828, p. 34.
" " Rich. & Swains. F. B. A. II, 1831, 88.
" " Latham, Index Orn. I, 1790, 57.
" " Aud. Orn. Biog. II, 1835, 135; V, 382; pl. cxxi.
Strix candida, Latham, Ind. Orn. Supp. 1801, p. 14.
Strix erminea, Shaw, Gen. Zoöl. VII, 1809, 251.
Strix arctica, Bartram, Trav. 1791, p. 289.
Strix nivea, Daudin, Traité d'Orn. II, 1800, 190.
Nyctea candida, Bonap. Geog. and Comp. List, 1838, p. 6.
Surnia nyctea, Aud. Syn. 1839, p. 21.
" " " Birds of Am. I, 1840, 113, pl. xxviii.
Nyctea nivea, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 190.
Vulg. — *The Snowy Owl. The White Owl. Great White Owl. Snow Owl.*

This is an exclusively Northern species, and is probably chiefly confined to the Arctic Circle and the adjacent portions of the temperate zone, in both the Eastern

and Western continents. It is only met with in the United States in midwinter, and is much more abundant in some years than in others. Individual specimens have been occasionally noticed as far south as South Carolina, but very rarely. It has also been observed in Kentucky, Ohio, the Bermuda Islands, and in nearly every part of the United States. On the Eastern continent it appears to be much less abundant, and its visits south are neither so frequent nor to the same extent. Although in one instance it has been known to breed on the Shetland Islands, very few instances are on record of its having been obtained in Great Britain, and only one in Holland. It is found in Iceland, Sweden, and Norway, and probably also throughout Northern Europe and Asia.

In the Arctic regions of North America and in Greenland it is quite abundant, and has been observed as far to the north as Arctic voyagers have yet reached. Sir John Richardson, who, during seven years' residence in the Arctic regions, enjoyed unusual opportunities for studying the habits of this Owl, says that it hunts its prey in the daytime. It is generally found on the barren grounds, but is always so wary as to be approached with difficulty. In the wooded districts it is less cautious.

It nests on the ground, and lays three or four globular white eggs, only two of which, Richardson states, are in general hatched.

I am unable to represent the egg in my plates, having never seen a specimen. I have only a drawing, made by Mr. Audubon, of a specimen in an English cabinet. It is nearly spherical, and its color is a dull white with a slightly yellowish tinge. It measures $2\frac{6}{10}$ inches in length by 2 inches in breadth.

SURNIA ULULA.

Strix ulula, Linn. Syst. Nat. I, 1766, 133.
Strix uralensis, Gmelin, Syst. Nat. I, 1788, 295.
Strix hudsonica, " " " " "
" " Wils. Am. Orn. VI, 1812, 64, pl. l, fig. 6.
Strix doliata, Pallas, Zoöl. I, 1811, 316.
Strix borealis, Lesson, Traité d'Orn. I, 1831, 100.
Strix funerea, Bonap. Syn. 1828, p. 25.
" " Rich. & Swains. F. B. A. II, 1831, 92.
" " Nuttall, Manual, I, 1832, 115.
" " Aud. Orn. Biog. IV, 1835, 350, pl. cccIxxviii.
" " De Kay, Nat. Hist. N. Y. 1844, pl. ix, fig. 19.
Surnia funerea, Bonap. Geog. and Comp. List, 1838, p. 6.
" " Aud. Syn. 1839, p. 21.
" " " Birds of Am. I, 1840, 112, pl. xxvi.
Surnia ulula, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 191.
Vulg. — *The Hawk Owl. Little Hawk-Owl. Le Chat-Huant du Canada* (Brisson).

I am unable to illustrate the egg of this species. The only knowledge that I possess, which seems to be authentic, in regard to the nest of these birds, as well as

in regard to their eggs, is derived from Richardson's Northern Zoölogy. We are there informed that it builds on a tree. Its nest consists of sticks, grass, and feathers. It lays two white eggs. It is exclusively an Arctic species, and is common to the northern regions of both continents. Occasional specimens are obtained in different parts of the United States, though none, so far as I am aware, farther south than New Jersey. It is, however, a rare species,[1] excepting in the Arctic regions, where it is said to be quite abundant. Only a single specimen is known to have been taken in Great Britain, and it has only occasionally been met with in Germany. From this we may infer that it is as rare a bird in the more temperate parts of Europe as in the corresponding regions of America.

[1] Mr. Audubon, in his account of the Hawk Owl, states that he had received a letter from me informing him that the Hawk Owl is very common about Memphremagog Lake in Vermont, &c. This was a mistake, and an unintentional misquotation of what I wrote. I did not make this statement as of my own knowledge, for I had never been in that region, but as the information given me by a resident of that part of the country, which I have since had reason to believe is incorrect. The Hawk Owl is probably a rare species throughout Vermont.

Order INSESSORES.

Tribe FISSIROSTRES.

Family CAPRIMULGIDÆ.

ANTROSTOMUS CAROLINENSIS.

Caprimulgus carolinensis, Gmelin, Syst. Nat. II, 1788, 1028.
" " Wils. Am. Orn. VI, 1812, 95, pl. liv, fig. 2.
" " Bonap. Syn. 1828, p. 61.
" " Aud. Orn. Biog. I, 1832, 273; V, 401, pl. lii.
" " Nuttall, Manual, I, 1832, 612.
" " Aud. Syn. 1839, p. 31.
" " " Birds of Am. I, 1840, 151.
" " Lembeye, Aves de la Isla de Cuba, 1850, p. 130.
Caprimulgus lucifugus, Bartram, Travels, 1793, p. 292.
Caprimulgus rufus, Vieill. Ois d'Am. Sept. I, 1807, 57.
Caprimulgus brachypterus, Stephens, Gen. Zoöl. X, 1817, 150.
Antrostomus carolinensis, Bonap. Geog. and Comp. List, 1838, p. 8.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 236.
Vulg. — *Chuck-wills-widow. The Great Carolina Goat-Sucker.*

Having had no opportunities of observing the Chuck-wills-widow in its extremely southern habitat, the present account of its habits and geographical range is necessarily drawn from the investigations, and given on the authority, of others. James River in Virginia has been assigned as the utmost northern limit of its migrations. It is, indeed, quite probable that it is seldom, if ever, found, except as an occasional visitant, so far to the north, although Wilson speaks of having met with it between Richmond and Petersburg, and on the Cumberland River. Dr. Bachman states that it is not a common bird even in the neighborhood of Charleston. Mr. Audubon, who claimed to have been a very close and careful observant of its habits, states, in his account of it, that it is seldom to be met with beyond the limits of the Choctaw nation in Mississippi, or the Carolinas on the Atlantic shore. Florida, Louisiana, the lower portions of Georgia, Alabama, and Mississippi, and probably Arkansas and Texas, are the States to which it is principally confined.

My friend, Dr. Kollock, informs me that it is rather common near Cheraw, in the northern part of South Carolina. Dr. Bryant found it abundant near Indian River, in Florida. Colonel McCall met with this bird in New Mexico. Lembeye gives it a place among the birds of Cuba. Dr. Woodhouse, in his report upon the birds observed by the expedition of Captain Sitgreaves down the Zuñi and Colorado rivers speaks of the *Caprimulgus carolinensis* as common in the Creek and Cherokee country, extending into Texas and New Mexico.

Like most birds of this family, the Chuck-wills-widow makes no nest, but deposits her eggs on the bare ground. These are two in number, and the places selected for them are usually thickets and solitary parts of dark woods. The ground color of their eggs is a clear crystal white. They are more or less spotted, or marked over their entire surface with blotches of purplish-brown and a grayish-lavender color, with smaller occasional markings of a light raw-umber-brown. They are oval in shape, large for the size of the bird, and alike at either end. The accompanying representation is taken from an egg obtained in Florida, by Dr. Henry Bryant, of Boston, who found the eggs of this bird in the same situations, in thick woods, that are mentioned by Mr. Audubon, deposited on the dry leaves, without any attempt at a nest.

According to the careful observations of this watchful naturalist, the Chuck-wills-widow, although it makes no nest, usually scratches a little space on the ground, among some dead leaves. In this she deposits her two elliptical treasures. If the eggs or the young are meddled with, this bird is sure to take alarm, and to remove them, each parent aiding, to some other and distant part of the wood. After a removal, it would be extremely difficult, if not impossible, to find them. This has been observed in respect to their eggs, and it is presumed that they do the same with their young, when these are quite small. Mr. Audubon spent much time in trying to ascertain by what means these birds remove their eggs when they have been touched or handled. He states that they are carried off in the capacious mouths of their parents. Each bird was observed by him, when on the watch for the purpose of ascertaining, to take an egg in this manner and fly off, skimming closely over the ground, until lost among the branches and trees. To what distance they were removed he was never able to ascertain. He has also known the young to be removed, and he presumed the removal to have been made by their parents in the same manner, although he was never eyewitness to it.

During incubation they are said to cease from repeating their peculiar cry, from which they take their name, especially after their young are hatched, although it is resumed before they depart on their southern migrations, in August.

In shape and marking, their eggs closely resemble those of the Whip-poor-will, differing only in their larger size. All that I have seen are broadly oval in shape, and measure $1\frac{7}{16}$ inches in length by $1\frac{1}{16}$ in the greatest breadth.

ANTROSTOMUS VOCIFERUS.

Caprimulgus vociferus, Wils. Am. Orn. V, 1812, 71, pl. xli.
" " Bonap. Syn. 1828, p. 62.
" " Aud. Orn. Biog. I, 1832, 422; V, 405; pl. lxxxii.
" " Nuttall, Manual, I, 1832, 614.
" " Aud. Syn. 1839, p. 31.
" " " Birds of Am. I, 1840, 155, pl. xlii.
" " Rich. & Swains. F. B. A. II, 1831, 336.
" " Lembeye, Aves de la Isla de Cuba, 1850, p. 130.
Caprimulgus virginianus, Vieill. Ois d'Am. Sept. I, 1807, 65.
Caprimulgus clamator, Vieill. Nouv. Dict. X, 1817, 234.
Caprimulgus macromystax, Wagler, Isis, 1831, p. 533.
Antrostomus vociferus, Bonap. Geog. and Comp. List, 1838, p. 8.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 236.
Vulg. — *The Whip-poor-will.*

The nocturnal habits of the Whip-poor-will do not enable the naturalist either very closely to observe them, or to ascertain them with accuracy. Much is necessarily inferred, rather than positively known, in regard to them. Seldom approaching the habitation of man, except in remote and thinly settled parts of the country, and then only in the obscurity of night, its singular note is nearly all that we are quite familiar with in regard to it. To this only can be attributed the singular fact that, notwithstanding the well-marked distinctions between it and the Night-Hawk, they have been, and still are, in many parts of the country, confounded together by the uninformed. The correctness of a statement to the same effect made by Mr. Wilson has been questioned by Mr. Audubon, but without good grounds. Unaccountable as it may appear, the vulgar error that these birds are the same is still very prevalent in many parts of New England, and even finds a place among those who are not wanting in intelligence upon other matters. Incapacitated by its optical conformation from going abroad in the daytime, the Whip-poor-will carefully conceals itself in the most retired and shady parts of deep woods. There it remains perfectly silent through the day, seldom disturbed by the steps of man. In these retreats this bird is rarely met with, and naturalists have but few opportunities to study its habits. The sight of the Whip-poor-will, like that of nocturnal Owls, appears not to be adapted to the light of day. Its chief food is nocturnal insects, obtainable only by twilight, or at night; it is therefore seldom seen abroad in the daytime, and then only in dark or cloudy weather. The habits both of the preceding species and the Whip-poor-will, so far as they have been observed, are closely identical with each other. Like the Chuck-wills-widow, the Whip-poor-will, if its eggs or young are handled, will remove them to another part of the woods. Wilson relates that, having once accidentally met with a young bird of this species, in passing through a wood, he stopped and sketched it. Returning to the same place in search of a pencil he had left behind him, after a short absence, the young bird was nowhere to be found. It had in the mean while, we are left to infer, been conveyed away by

its parent, who had, in the first place, sought in vain to entice the intruder away by well-feigned stratagems. Mr. Audubon's observations in the case of the Chuck-wills-widow suggest the manner of its removal.

If disturbed by a too near approach to her eggs or her young, the Whip-poor-will attempts to draw off the intruder by well-acted feints, fluttering about his feet as if wounded, or beating the ground with her wings, as if hardly able to move, or nearly expiring.

Massachusetts is the extreme northern limit of its distribution along the Atlantic coast. It is nowhere very abundant near the sea, but becomes more common as we leave the coast, and as we proceed westward is found much farther to the north. In the central parts of the continent, it has even been met with in latitude 49°. It is to be met with nearly throughout the United States, with the exception of the extreme northeastern and southern and southwestern portions.

Sir John Richardson observed this bird on the northern shores of Lake Huron only, but did not meet with it north of the fiftieth parallel. Dr. Hall, of Montreal, mentions it as a Canadian bird. It is found in all the New England States, but is less common north of Massachusetts. In a list of the birds of Nova Scotia, prepared by Lieutenant Bland, Royal Engineers, the *Caprimulgus vociferus* is given as a rare species. Mr. Lembeye gives it as a Cuban species, and Bartram found it in Florida. Dr. Woodhouse, in his account of the birds noticed by the party who explored the Zuñi and Colorado rivers, under Captain Sitgreaves, did not meet with this species, nor can I learn that it has been met with west of the Mississippi.

The Whip-poor-will constructs no nest, but deposits her eggs on the bare ground, in the thickest and most shady part of the woods. They always select elevated and dry places, and usually scratch a small hollow among some dry leaves or sticks, or near some prostrate log, in which they deposit their two elliptical eggs. The young, when just hatched, are perfectly helpless, and depend for their safety upon their resemblance to a piece of mouldy earth. They are very soon able to follow their parents, and to take care of themselves.

The egg of the Whip-poor-will is not much unlike that of the Night-jar of Europe. It is oblong and oval, each end nearly exactly alike in size and shape. Nothing could well surpass it in the beauty of its markings. Its ground color is a clear pure shade of cream-white, and the whole egg is irregularly spotted and marbled with patches, lines, and bars of purplish-lavender intermixed with reddish-brown. The lavender-colored markings have a very peculiar effect, as if, after the color had been first laid on, a thin coating of the ground shade had been superadded, so as to slightly dim, without concealing them. The brown markings appear to stand out much more distinctly. The eggs also exhibit slight variations in the distribution of these tints. In some, the brown-colored markings predominate, in others the lavender spots are the more abundant; but I have seen none in which either of these shades was wanting. The egg measures $1\frac{1}{4}$ inches in length by $\frac{7}{8}$ of an inch in breadth.

In the Southern and Middle States, the Whip-poor-will deposits her eggs as early as the first or second week in May. In Massachusetts and its more northern and western places of resort, it seldom sits on its eggs before the first week in June. It

does not remain in its breeding-places long after it has reared its first and only brood for the season. As soon as its young are ready for the journey, they all depart for their southern quarters, which is usually in the month of August. They are silent in the breeding season, but resume their peculiar cries as soon as their young are able to take care of themselves.

ANTROSTOMUS NUTTALLII.

Caprimulgus nuttallii, Aud. Orn. Biog. V, 1839, 335.
" " " Birds of Am. VII, 1844, 350, pl. ccccxcv.
Antrostomus nuttallii, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 237.
Vulg. — *Nuttall's Whip-poor-will. Parauque* (Matamoras, Tamaulipas).

The egg represented in Plate V, fig. 58, was found among the collection of Dr. Berlandier, and obtained by that gentleman in the vicinity of Matamoras in the Province of Tamaulipas, Mexico. It is not positively known to be the egg of this newly-discovered species, yet I have very little doubt that it is so. Its shape, markings, and general characteristics show it to be an egg of a *Caprimulgus*, and its size indicates as its parent a bird not larger than this species, which is the only one now known to be found in that neighborhood. The only name bestowed upon it by Dr. Berlandier was Parauque, by which he also designated another egg, supposed to be that of a *Chordeiles*, and which I presume to belong to the species recently described by George N. Lawrence, Esq. as *C. texensis*.[1] Nothing is said, in his notes, of the habits of the bird described under the name of Parauque, its manner of breeding, or the peculiarities of the eggs. The description of the birds is quite obscure, and designates with certainty no known species. The probability is, however, so strong that the egg referred to is that of *Caprimulgus nuttallii*, and that the one represented in Plate V, fig. 62, is the egg of *C. texensis*, that I have felt justified in including both among the illustrations, stating only the uncertainty of the ground upon which the assignment rests.

The *Caprimulgus nuttallii* was first obtained by Mr. Audubon near the Rocky Mountains in the Northwest Territory, and was described by him in the fifth volume of the Ornithological Biography (p. 335). Nothing was observed by that writer of its habits. It was obtained in Oregon by the United States (Vincennes) Exploring Expedition. Specimens have been procured in Washington Territory by Drs. Cooper and Suckley. Mr. T. H. Clark obtained it in Texas, and Dr. Woodhouse, in the expedition to the Zuñi, in passing down the Little Colorado River, found this species quite abundant. He also met with it afterwards in the San Francisco Mountain, near the same river. In the collection made by Dr. Woodhouse there are several

[1] Ann. Lyc. Nat. Hist. VI, 167.

specimens of this bird, both male and female, exhibiting no observable variation in their plumage. These observations fix with some probable approach to exactness the distribution of this handsome species during the breeding season, showing that it is found throughout Texas, New Mexico, the more northern provinces of Mexico, the Indian Territories, Kansas, and Nebraska, and thence to the Pacific; and that it is in all probability to be found in the State of California, as well as in the Territories of Washington and Oregon.

The peculiar and uncertain blending of shades make a verbal description of the eggs supposed to belong to this species difficult and unsatisfactory, and one which can only be approximated. It is almost exactly elliptical in shape, equal at either end, measures 1 inch in length and $\frac{12}{16}$ of an inch in breadth. Its ground color, examined through a magnifying-glass, appears to be a yellowish-white, but is so generally marbled and spotted with blotches of a purplish-gray and smaller spottings of a light umber-brown, that the ground is hardly distinguishable to the naked eye.

CHORDEILES VIRGINIANUS.

Caprimulgus virginianus, Brisson, Orn. II. 1760, 477.
" " Bonap. Syn. 1828, p. 62.
" " Rich. & Swains. F. B. A. II, 1831, 337.
" " Nuttall, Manual, I, 1832, 619.
" " " " II, 1834, 609.
" " Aud. Orn. Biog. II, 1835, 233; V, 407; pl. cxlvii.
Caprimulgus popetue, Vieill. Ois d'Am. Sept. I, 1807, 56, pl. xxiv.
Caprimulgus americanus, Wilson, Am. Orn. V, 1812, 65, pl. xl.
Chordeiles virginianus, Bonap. Geog. and Comp. List, 1838, p. 8.
" " Aud. Syn. 1839, p. 32.
" " " Birds of Am. I, 1840, 159, pl. xliii.
" " Gosse, Birds of Jamaica, 1847, p. 33.
" " De Kay, Nat. Hist. N. Y., Birds, 1844, pl. xxvi, fig. 60.
" " Lembeye, Aves de la Isla de Cuba, 1850, p. 51.

Vulg. — *The Night-Hawk. The Pisk. Peesquaw* (Cree Indians). *Musquito-Hawk. Piramidig* (Jamaica). *Berequetec* (Cuba).

The geographical distribution of the Night-Hawk is very nearly the same as that of the Whip-poor-will, though somewhat more extended. While not found, in its breeding season, quite so far to the south, its distribution, especially along the Atlantic coast, extends considerably farther to the north. I have met with it throughout the provinces of Nova Scotia and New Brunswick. It has been found in all parts of Canada, and has even been met with breeding as far to the north as the shores of Hudson's Bay. It is also widely diffused from east to west, although the extent of its distribution in the latter direction is not known with exactness or cer-

tainty. They have been at least ascertained to extend as far to the west as the sources of the Mississippi. The extreme southern point at which it is known to breed is the northern portion of Georgia and South Carolina. Throughout nearly the whole of this wide range, the Night-Hawk appears to be distributed in about equal numbers.

In many of its habits, as well as in its external generic distinctions, this bird exhibits so many and so broad differences from the Whip-poor-will, that there is little apparent occasion to confound them. It is much less nocturnal in every respect, and is not, strictly speaking, entitled to its name of Night-Hawk. It is rather to be regarded as occupying more nearly a middle ground between nocturnal and diurnal birds. It is not unfrequently to be seen on the wing, even in bright, sunny weather, at midday, in pursuit of its winged prey. It is, however, usually most lively early in the morning and just before nightfall, and is usually inactive and slothful in the middle of the day. It is not improbable that its supply of food has much to do with its sluggishness or state of activity. The Night-Hawk is not to be found on the wing after dark. As soon as the twilight begins to deepen into the shades of night, it retires to rest as regularly, if not at quite as early an hour, as other birds, in regard to whose diurnal habits there is no question.

In some of its peculiarities at the time of breeding, the Night-Hawk also displays very marked variations from the habits of the Whip-poor-will at the same period. While the latter always deposits its eggs under the cover of shady trees and in thick woods, the Night-Hawk selects an open rock, a barren heath, or an exposed hillside for its breeding-place. This is not unfrequently in wild spots in the vicinity of a wood, but is always open to the sun. I have even known the eggs carelessly dropped on the bare ground in a corner of a potato-field, and have found the female sitting on her eggs in all the bright glare of a noonday sun in June, and to all appearance undisturbed by its brilliance. The more common situation for the eggs is a slight hollow of a bare rock, the dark, weather-beaten shades of which, with its brown and slate-colored mosses and lichens, resembling at once the parent and the egg in their coloring, is well adapted to save them from being detected by any chance intruder. If approached when sitting on her eggs, the female will usually suffer you almost to tread upon her before she will forsake them. Then, to draw you from her treasure, she will tumble about and flutter at your feet with an imitation of a wounded bird so perfect, an adroitness in pretending disability so inimitable, that it is hardly possible to resist the temptation to follow in pursuit of her. I know of no better or more skilful adept in these cunning devices than the Night-Hawk.

The eggs of this bird are two in number, and except in their shape, which is uniformly elliptical, exhibit great variations. They vary in size, in their ground color, and in the shades, shape, size, and number of their markings. Yet notwithstanding all these differences in their general effect, they are alike. They all closely resemble oblong-oval, dark-colored pebble-stones. The design of this resemblance is obviously to assure their safety in the exposed situations in which they are placed, causing them to be readily confounded with the stones among which they lie. Six eggs

now by me exhibit the following varying measurements, none of which, it will be seen, exactly correspond: $1\frac{5}{16}$ inches by $\frac{7}{8}$; $1\frac{1}{4}$ by $\frac{29}{32}$; $1\frac{1}{4}$ by $\frac{27}{32}$; $1\frac{3}{16}$ by $\frac{7}{8}$; $1\frac{5}{32}$ by $\frac{27}{32}$; $1\frac{1}{8}$ by $\frac{15}{16}$. In these the ground is of various shades of stone-color; in one, almost a dirty white; in another, with a slight tinge of yellowish; in a third, the shading is somewhat bluish, and in yet another again it is almost clay-colored. The spots and markings, which are thickly diffused over the whole egg, also vary more or less in each specimen. One is finely dotted with small specks of light slate and yellowish-brown. In another, the spots are of the same colors, but are larger and more distinct, and seem as if laid on with a bolder pencil. Again, in a third, they are lighter and more indistinct than in either, the shade of yellow more predominant, and each blending confusedly into the other. In a fourth, the spots are again small, but are all of a dark-brown color, while the remaining two are marbled, but in different degrees, with large lines, veins, and dashes of the same color. With an increased number of specimens these variations might without doubt be extended indefinitely. Still, notwithstanding all these deviations, the egg is readily distinguishable, for I know of no egg, certainly no American, which in shape, size, and markings it at all resembles, with the single exception of an egg which is presumed to belong to the following species.

In regard to the geographical distribution of this species, later observations, published since the above was prepared, are confirmatory of all that has been stated, but do not make our knowledge quite exact as to its western distribution. It is assigned by Mr. Cassin to all temperate North America, and probably passes this limit. Dr. Townsend obtained specimens in Oregon; Dr. Heermann, also, in California; Dr. Hall mentions it in a catalogue of the Birds of Canada which he furnished to Mr. Cassin; Dr. Woodhouse found it throughout the south and west, from the Mississippi River to the Pacific Ocean, in great abundance; Colonel McCall observed it in New Mexico; and specimens from Mexico occur in the Rivoli collection. It has been found also in Nicaragua by Barruel, in Jamaica by Gosse, and in Cuba by Lembeye and Gundlach. Lieutenant Bland, in his catalogue of the Birds of Nova Scotia, mentions it as "common, migratory, and breeding" in that Province. From this it is to be inferred that during the breeding season it has one of the most extended ranges among North American birds, — from Central America on both the Atlantic and Pacific shores to the extreme north.

CHORDEILES TEXENSIS.

?? Chordeiles sapiti, Bonap. Cons. Av. 1849, p. 63.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 238.
Chordeiles brasilianus, Lawrence, Ann. Lyc. Nat. Hist. of N. Y. V, 1851, 114.
Chordeiles texensis, " " " " " " " VI, 1856, 167.
Vulg. — *Parauque* (Berlandier, Matamoras).

Nothing is known in regard to the habits, and but little as to the distribution, of this newly discovered species. A bird supposed by Mr. Cassin to be the same is given by Bonaparte (Cons. Av. 1849, p. 63), and is very similar in form and general appearance to the preceding species. It differs chiefly in its size. In a paper read before the New York Lyceum, April, 1851, by George N. Lawrence, Esq., of New York, giving a list of additional birds to the North American Fauna, reference is made to this bird as *Chordeiles brasilianus* of Gmelin. In a subsequent paper, read December, 1856, it is described as a new species, under the name of *Chordeiles texensis*. The egg represented (Plate V, fig. 62) is supposed to be that of this species, in part from the description of the parent bird given by Dr. Berlandier, in whose collection it was found, and partly from its apparent affinity, in all but size, to the eggs of the common Night-Hawk. It is possible, however, that it may be the egg of the latter, though it is smaller, and its markings are of a lighter shade, than I have ever observed in the eggs of that bird.

The *C. texensis* has been observed in Texas, by Mr. Clark and Captain McCown; also in New Mexico, Mexico, and Central America, by other naturalists.

The egg presumed to have belonged to a bird of this species may be described as follows: length $1\frac{3}{16}$ inches, breadth $\frac{14}{16}$ of an inch; ground color a clear crystal-white, but so closely covered with overlying markings as not to be discernible except when examined through a magnifying-glass. The egg is marked over its entire surface with small, irregular confluent spots and blotches of a color that seems a compound of black, umber, and purplish-gray. The general appearance of the egg is that of a dark-grayish marble, and, as stated, it is smaller and of a lighter color than that of the common Night-Hawk.

Family HIRUNDINIDÆ.

HIRUNDO RUFA.

Hirundo erythrogaster, Boddaert, Tab. Pl. Enl. 1783, p. 45. (?)
Hirundo rufa, Gmelin, Syst. Nat. I, 1788, 1018.
" " Bonap. Syn. 1828, p. 24.
" " Nuttall, Manual, I, 1832, 601.
" " " " II, 1834, 607.
" " Bonap. Geog. and Comp. List, 1838, p. 9.
" " De Kay, Nat. Hist. N. Y. 1844, pl. xxix, fig. 64.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 243.
Hirundo horreörum, Barton, Frag. Nat. Hist. of Pa. 1799, p. 17.
Hirundo americana, Wils. Am. Orn. V, 1812, 34, pl. xxxviii, figs. 1 and 2.
" " Rich. & Swains. F. B. A. II, 1831, 329.
" " Lembeye, Aves de la Isla de Cuba, 1850, p. 44.
Hirundo cyanopyrrha, Vieill. Nouv. Dict. XIV, 1817, 510.
Hirundo rustica, Aud. Orn. Biog. II, 1835, 413; V, 411; pl. clxiii.
" " " Syn. 1839, p. 35.
" " " Birds of Am. I, 1840, 181, pl. xlviii.

Vulg. — *American Barn Swallow. Barn Swallow. Swallow. Chimney Swallow. Golondrina Bifurcata. American Swallow.*

None of our more common birds are better known or are more universal favorites than the familiar, graceful little Barn Swallows. They are not welcomed merely as the early harbingers of milder skies and summer weather; we greet with even greater pleasure in them the return of gladsome and cheerful companions, — of pleasant and joyous visitors, ever welcome because they never abuse the hospitality they receive. The confiding trust with which they enter the barns and out-buildings of the farmer, or will even venture into the very midst of our most crowded cities, and construct their curiously elaborate nests over our windows and door-sills, wins them an easy way to our affectionate interest. Even this interest is not a little increased and confirmed as we know more of their blameless and innocent lives. Social, affectionate, and kind in their intercourse with their fellows; unceasingly devoted to each other in their conjugal loves and duties; exemplary in their attachment to, and constant, watchful, and faithful in their zealous care of, their offspring; sympathizing, active, and benevolent when their kindred or associates are in difficulties, — there are few indeed among us who might not find, in the daily life of these graceful and lovely birds, bright examples of fidelity to social duties and the practice of domestic virtues which we need not be ashamed ourselves to imitate. In all its intercourse with man, it is his constant benefactor and friend. In no instance is it known, even indirectly, to do him the least injury. It makes its daily food the insects that annoy his cattle, injure his trees, devour his fruit, or attack his own person. Its benefits are unalloyed by any mischievous propensities.

It is therefore hardly to be wondered at that the American Barn Swallow is so general a favorite.

The range of the Swallow is nearly coextensive with North America. Sir John Richardson observed numbers of them, in the month of May, at Fort Good Hope, the most northerly post of America, latitude 67° 30′. The same writer also observed them at Fort Chippewyan, latitude 57°, as early as the 15th of May, taking possession of their nests. They are abundant in Canada, and also in all the British provinces. Dr. Townsend observed them in Oregon, Colonel McCall met with them in New Mexico, and Dr. Woodhouse, in his Report of the Zuñi Expedition under Captain Sitgreaves, speaks of this species as common throughout certain portions of the Indian Territory and Texas, as well as New Mexico. He also found it very abundant, in company with *H. lunifrons*, on the prairies north of the Red Fork of the Arkansas River. Dr. Gundlach and Mr. Lembeye both give it as one of the common birds of Cuba, but Mr. Gosse does not mention it as among those of the neighboring island of Jamaica.

Little is now known with certainty in regard to the localities that were once the natural breeding-places of these birds before the country was settled by civilized man, and before there were any of the present convenient buildings to tempt them to a general and nearly universal desertion of their primitive haunts. We are, however, led to conjecture, from their being occasionally found to make use of the sides of an old well, the abutment of a bridge, or the walls of the natural "sink-holes" which abound in a limestone country, that steep, overhanging rocks, cliffs, caves, and similar places, must have been their chief dependence and resort until they could find safer and more convenient sites in the barns and sheds of the first settlers. Swallows' Cave at Nahant, even within the recollection of many, has been one of these original and primitive breeding-places.

In the Fur countries, where the habitations of man are few and far between, according to Richardson, it inhabits caves, particularly in limestone rocks, and frequents the outhouses of the trading-posts. This is also the case in the vicinity of the Lake Superior copper-mines.

Both Wilson and Audubon have given with so much minuteness and accuracy descriptions of the nest of this bird, that I can hardly hope to add anything to their accounts of its elaborate and beautiful structure. A nest which I very carefully examined while preparing this paper, and which was constructed at the junction of two rafters, under the roof of a barn, intersecting each other at a right angle, furnishes me with what are sufficiently near the average measurements. One of these rafters was placed horizontally; upon this the nest rested. On the left side, against the upright rafter, had been constructed by the pair a very curious platform, which was used by them as a roosting-place, and upon which each partner alternately rested, in order to keep company with and cheer the mate, when occupied with the duties of incubation. Wilson, in describing the nest, speaks of this platform as an extension of its edge, or as an offset. In the present case, it was an independent and separate structure, though closely adjoining the nest. It seemed to afford room sufficient for both birds to occupy it together, when their young were large enough

to fill the nest. It was three inches in length and nearly an inch and a half in breadth, united with the nest only at its extremity. Mr. Audubon states that he never met with this expansion in one recently constructed.

The nest I have referred to was made up of ten distinct and separate layers of mud, worked into small pellets and placed in close juxtaposition. Between each of these layers were interposed successive strata of fine dry grass. The nest measured externally less than five inches in depth, and over five in its largest diameter. The average thickness of its mud wall was about an inch. It was warmly stuffed with fine soft hay, and thoroughly lined with downy feathers. The cavity was two inches deep in its centre, and its largest diameter was three inches. This nest had been several years in constant use by what is presumed to be the same pair of Swallows. Although from eight to ten young have been reared from it yearly, for the last six years, at least, none of them are known to have returned to the shelter of the same roof to increase and multiply in their turn. This suggests the remark, that, although I have occasionally found them, as described by Wilson, Audubon, and Nuttall, breeding together in the larger barns of the farmers, several pairs under the same roof, I have as often found, as in the present instance, a pair occupying for successive years the same locality, without any companions.

Mr. Audubon's measurements of the nest figured by him exceed those here given. This may be owing to his having taken for his subject a nest that was not rested upon, but built against, a rafter, or the side of a building. The stronger and more solid foundation required to support it in that position would explain its superior length and size, as well as account for its more conical shape.

In favorable seasons the Barn Swallows raise two, rarely three, broods in the same year. The number is usually five, often four, but rarely six, in a brood. Nothing can be more interesting than to watch the first lessons in the art of flying and feeding themselves given to the young Swallows by their parents, their stratagems to entice them from their nest, the support given them in their descent to break their fall, and the attentive watchfulness of the one contrasted with the timid awkwardness of the other.

The ground color of their eggs is pure white. When fresh, their shell is so thin and transparent that their yolk imparts to them a beautiful roseate tint. They are marked with spots, usually of a reddish but occasionally of a purplish brown, chiefly at the larger end, varying in number and size. The eggs are smaller, more elongate, and the spots with a more distinctly reddish shade, than those of the Cliff Swallow. They vary in their shape as well as in their markings. One now before me, unusually elongated, measures $\frac{1}{1}\frac{5}{6}$ of an inch in length and only $\frac{8}{1}\frac{}{6}$ in its greatest breadth. Another is $\frac{1}{1}\frac{2}{6}$ by $\frac{1}{1}\frac{0}{6}$. It will at once be seen how much these two eggs must differ in their shape.

The following are the measurements of a large series of the eggs of this bird: greatest length $\frac{1}{1}\frac{5}{6}$ inch; least do. $\frac{1}{1}\frac{2}{6}$ inch; average do. $\frac{2}{3}\frac{5}{2}$ inch. Average breadth $\frac{9}{1}\frac{}{6}$ inch; greatest do. $\frac{1}{1}\frac{0}{6}$ inch; least do. $\frac{8}{1}\frac{}{6}$ inch.

HIRUNDO LUNIFRONS.

Hirundo lunifrons, Say, Long's Exp. to Rocky Mountains, II, 1823, 47.
" " Rich. & Swains. F. B. A. II, 1831, 331.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 243.
Hirundo opifex, Clinton, Ann. Lyc. Nat. Hist. of N. Y. I, 1824, 161.
Hirundo respublicana, Aud. Ann. Lyc. Nat. Hist. of N. Y. I, 1824, 164.
Hirundo fulva, Bonap. Am. Orn. I, 1825, 63, pl. vii, fig. 1.
" " " Syn. 1828, p. 64.
" " Nuttall, Manual, I, 1832, 601.
" " Aud. Orn. Biog. I, 1832, 353; V, 415; pl. lxviii.
" " Nuttall, Manual, II, 1834, 607.
" " Bonap. Geog. and Comp. List, 1838, p. 9.
" " Aud. Syn. 1839, p. 35.
" " " Birds of Am. I, 1840, 177, pl. xlvii.
" " De Kay, Nat. Hist. N. Y., Birds, 1844, pl. xxx, fig. 64.

Vulg. — *Cliff Swallow. Fulvous Swallow. White-nosed Swallow. Republican Swallow. Eave Swallow. Rocky Mountain Swallow. Mud Swallow. White-fronted Swallow.*

The careful investigations of Mr. John Cassin, of Philadelphia, have very clearly established sufficient specific differences between the Cliff Swallow of the United States and the *Hirundo fulva* of Viellot to justify their separation into distinct species. The specific name of *lunifrons*, first given to our species by Mr. Say, belongs to it, therefore, by the strict rules of nomenclature, and well expresses its most striking characteristic. In some parts of New England these new-comers are distinguished from the common inmate of our barns by the name of the "White-faced Swallow."

The history of this social bird, in all that relates to its mode of breeding and its habits at that busy period, is replete with interest and full of attractive incidents. Intimately connected with its domestic economy arises the difficult problem of its geographical distribution, past and present. The opinion is very generally entertained, and certainly has the weight of evidence in its favor, that the Cliff Swallow was formerly found only on the western side of the continent, and that its appearance on the Atlantic coast has been a very recent occurrence. A negative fact of this nature is not often so susceptible of positive proof as naturalists would usually insist upon. It is now too late to establish by certain evidence, and beyond all doubt, the fact of its former absence from our Atlantic shores. Yet it would certainly be difficult, I am almost justified in saying impossible, to reconcile with its presence, now so conspicuously manifest, the profound ignorance of its very existence that prevailed until within a few years. There are not wanting, however, those who are not ready to admit the correctness of conclusions apparently so well founded. Some boldly contend that it has always been here, but that its presence has somehow been unaccountably overlooked by naturalists, though known to the common people. Others urge the hardly less improbable supposition that it has always existed on the more northern portion of the eastern coast, where naturalists have only recently pushed

their investigations, and that they have not since very materially extended the area of their habitat. In favor of this theory, they appeal to the fact that Vieillot was one of the first to receive a specimen of this bird obtained at sea off the coast of Nova Scotia. It is true that these birds are much more abundant in the British Provinces, in Maine, and in the northern parts of New Hampshire, Vermont, and New York, than elsewhere this side of the Alleghanies. They are also well known to have existed in those localities long before they appeared in places farther south, where their presence is also known to be of very recent date. Still, my own impressions favor the belief that its presence to any considerable extent on this side of the Mississippi valley is an event at least coincident with their discovery by Major Long, and that, in its migrations eastward, this species has followed the shores of the great lakes and the banks of the Ohio and other tributaries of the Mississippi. Spreading out from these great highways, they have peopled the country around, and extended their busy colonies to their present habitat far to the south and east. In these views I am indirectly confirmed by the observations of Sir John Richardson, who in his description of the habits of this species (Fauna Boreali-Americana, II, 331) makes the following interesting observations: —

"This species was discovered by Major Long in 1820. It was seen the same year in great numbers by Sir John Franklin's party on the journey from the Cumberland House to Fort Enterprise, and on the banks of Point Lake, in latitude 65°. Its clustered nests are of frequent occurrence on the faces of the rocky cliffs of the Barren Grounds, and are not uncommon throughout the whole course of the Slave and Mackenzie rivers. On the 25th of June, in the year 1825, a number of them made their *first appearance* at Fort Chippewyan, and built their nests under the eaves of the dwelling-house, which are about six feet above a balcony that extends the whole length of the building, and is a frequent promenade. Fort Chippewyan has existed for many years, and trading-posts had been established in the Fur countries for a century and a half; yet this is the first instance of this species of Swallow placing itself under the protection of man within the widely extended lands north of the great lakes. What cause could have thus suddenly called into action that confidence in the human race with which the Framer of the universe has endowed this species, in common with others of the Swallow tribe?"

It is not improbable that this species has not even now reached the final limits of its migrations. It is at least certain, that, wherever met with, the inhabitants almost invariably speak of them as new-comers, and give very exact and generally recent dates for their first appearance in the neighborhood.

The cause of this remarkable change of locality may readily be found in the greater conveniences for breeding-places supplied by the spread of civilization in the country. The eaves of houses, barns, and other buildings, furnish much safer shelter against storms, and greater security against their natural enemies, than the steep cliffs, rocks, and river-banks which formed their original breeding-places. To similar superior attractions presented by the dwellings of man may we also attribute corresponding changes in the natural habits of other species of the Swallow tribe. The common Swallow, on the appearance of man, at once deserts his natural haunts

for the beams and rafters of barns and out-buildings, and even ventures into the streets of crowded cities for convenient sites, alike on private and on public buildings.[1] The Purple Martin, the Swift, and the White-bellied Swallow leave the hollow trees and stumps that formed their original nesting-places, for the chimneys of dwelling-houses, or boxes adapted to their wants by their human friends, and so disposed as to attract them around their dwelling-houses.

Mr. Audubon first met with this species on the Ohio River, at Henderson, in 1815. Two years later, he found a colony breeding in Newport, Ky., opposite to Cincinnati, which dated back to the same year for its origin. So also did several other colonies in the immediate neighborhood.

Their presence in New England was first made known to me by receiving, in 1837, some of their eggs, from the town of Coventry, in Vermont, near Lake Memphremagog. The birds were designated as "Eave Swallows." How long they had been known there I was never able to ascertain. DeWitt Clinton mentions that they made their first appearance at Whitehall, New York, on the southern extremity of Lake Champlain, as early as 1817.[2] It is quite probable they were really present in various other places in that neighborhood several years before naturalists were made aware of it. In the year following, they were noticed by a gentleman whose word is good authority, at Crawford's, near the base of the White Mountains in New Hampshire. In 1830, General Dearborn observed them for the first time in Winthrop, in Maine. It is to be regretted that our knowledge of their first appearance in different parts of the Atlantic States is so imperfect, limited as it is to only a few unconnected observations, remote in point of time, in scattered localities, and presenting, in consequence, no connected chain, or any available clew by which we may trace with any degree of certainty the course followed in their migrations into their new haunts. Even at the present day, there are so few to watch their movements, that very little is known as to the extent of their actual increase throughout the country, or even whether they are increasing. The scattered observations seem to justify the belief, that they have become very generally diffused from Southern Pennsylvania throughout the northern and eastern portion of the continent.

I am not aware that it has been observed on the Atlantic coast farther south than Pennsylvania,[3] or even in the States bordering upon the Gulf of Mexico, until we

[1] Since the above was written, and while these pages are passing through the press, a small colony of Cliff Swallows have taken possession of the freestone front of the Boston Athenæum, immediately upon a frequented street, have there constructed their curiously elaborate nests, and reared their young in security, undisturbed either by the busy throng beneath or the attentions of curious boys.

[2] Annals of the Lyceum of Natural History of New York, I, 160. "The Swallow which forms more especially the subject of this communication first made its appearance at Winchell's Tavern, on the high-road about five miles south of Whitehall, near Lake Champlain, and erected its nest under the eaves of an outhouse, where it was covered by the projection of the roof. This was in 1817, and in this year there was but one nest; the second year, seven; the third, twenty-eight; the fourth, forty; and in 1822, there were seventy, and the number has since continued to increase." (Read in 1824.)

[3] Professor Baird of the Smithsonian Institution informs me that it was first observed at Carlisle, Pennsylvania, in 1841, since which time it has become very abundant. He does not know of its existence in the Atlantic States south of Pennsylvania.

come to the valley of the Mississippi. It is abundantly distributed along the Pacific shores, from Southern California to Russian America. Dr. Townsend met with it in great numbers in Oregon; Drs. Gambel and Heermann and Mr. Samuels found it abundant throughout California; Colonel McCall met with it also in New Mexico; and Dr. Woodhouse (Expedition down the Zuñi and Colorado Rivers, p. 64) speaks of this species as very common throughout the Indian Territory, Texas, New Mexico, and California. Sir John Franklin's party observed this bird in 1820, (the same year that it was first discovered by Major Long's party, near the Rocky Mountains,) on the journey from Cumberland House to Fort Enterprise, and on the banks of Point Lake, in latitude 65° north. This is the highest northern point to which it has been traced, so far as I am aware.

I met with these birds for the first time in 1839, in Jaffrey, N. H., where a large colony had taken possession of the side of an old church, filling its eaves with nearly a hundred of its curiously formed nests. This large colony had made its first appearance in that town only the year previous. After flying about, apparently in some uncertainty where to found their little city, they finally pitched upon the side of a large barn in the midst of the village. The inhospitable treatment they received from the boys of the village soon drove them from this place, to find, later in the same season, in the high eaves of the church, a safe asylum against the poles and ladders of their inhospitable tormentors. In the course of the same year, I met with several families of this Swallow in the vicinity of Burlington, Vt. They had been commenced, I was informed, only a few years previously. A few pioneers only appeared the first year, but the following spring they were succeeded by large colonies. In almost all instances, the first appearance of these birds in any section of the country has been in places not far from watercourses, but this has not been universal.[1]

It was several years after this Swallow was known to have become quite common in Maine, New Hampshire, and Vermont before we have any knowledge of it in any part of Massachusetts, though probably there some years before it was discovered. In 1842, I saw a large colony on the sides of a church in Attleborough, founded the year before. The same year attempts were made to found colonies in Hingham, but the sandy nature of the soil, which made the construction of their nests very difficult, and liable to fall to pieces as soon as the materials dried, have never favored their increase in that town, though a few have bred there each year since that period, but chiefly in solitary pairs. Connected with these unsuccessful attempts, many of which came at the time under my daily notice, are several interesting incidents, attesting at once the industry and perseverance, as well as the sagacity, of these birds. One of these I will mention.

In the summer of 1843, a pair of Cliff Swallows, supposed to belong to a colony that had attempted unsuccessfully to make a settlement in the neighborhood, and had abandoned it in disgust at the friable nature of their structures, more perse-

[1] Rev. Zadock Thompson, in his History of Vermont, mentions the appearance of the Cliff Swallow in Randolph, an inland town, very soon after their being first noticed at Whitehall.

vering than their associates, selected a sheltered corner, under the piazza of a dwelling-house near the steamboat landing. It was directly over the front door of the house, and opposite to a window from which the birds could be readily overlooked while at their work. For several days the industrious pair persevered in their Sisyphean task. As fast as the materials dried, their nest would crumble into powder. Each morning found them in no wise advanced in their labors. In the mean while, the incredibly large accumulations of dirt under their nest, collected in vain by these persevering little creatures, sorely taxed the forbearance of the lady of the house, but who, in spite of the dirt they made about her threshold, watched their progress with a benevolent and a forbearing interest. At length the birds themselves appeared to realize the necessity of some change in their proceedings. After some four or five days' unsuccessful toil, they paused, and seemed to be hesitating whether to abandon the attempt altogether, or to try other materials. It was late in the season, — July. No time was to be lost. After a day's interval of deliberation their labors were renewed; but this time pellets of soft cow-dung were carefully interposed between each layer of muddy sand, and, in a wonderfully short space of time, a firm and lasting nest was constructed, in which five young were reared in safety. Was this all instinct? Was there not more than a mere scintillation of reason, suggesting this change and the substitution of a novel material?

The nest of the Cliff Swallow, under favorable circumstances, is constructed with a degree of ingenuity that is truly wonderful. In shape it is not unlike a gourd, with a handle curving downward. The larger part is against the wall, or the side of the object to which the nest is attached, while its entrance is through the lower end of its narrow neck. Its arched roof furnishes complete protection against inclement weather, while its narrowed and descending entrance shields the brood from their various enemies. In situations where these precautions are not so necessary as in their natural resorts, or where the presence of man keeps their natural enemies at a distance, they often deviate from their normal structure, curtailing or even dispensing altogether with the neck-like entrance. A large colony which I met with on a small island near the mouth of the Bay of Fundy,[1] availing themselves of a protected shelf under the eaves of a barn, prepared for them by the friendly owner, omitted in many instances even the protecting roof, no longer required for their shelter.

Their nests are constructed of various kinds of adhesive earths and mud. Both birds labor incessantly at the task of construction, and, when in colonies, receive assistance from their neighbors. They are neatly and often warmly lined with fine

[1] This was observed in 1851. At that time it was the only settlement of this bird noticed in that locality. Dr. Henry Bryant, who visited the same place in the summer of 1856, in a paper read before the Boston Natural History Society, January, 1857, says, having reference unquestionably to this species: "By far the most common Swallow, particularly at Manan. The nests were almost universally built without the projecting neck. Of late years, these birds, as they become more habituated to building in sheltered situations, have nearly discontinued their former habit of building their nests in a retort shape." This is interesting, as showing that in the course of five years the single colony we met with had so far multiplied as to have become the most common Swallow in that group of islands.

dry grass, soft leaves, and straw, intermixed with occasional feathers, down, and wool. It is thought by some, that, in constructing their nests, the mud of which the foundation is composed is tempered by these birds with their glutinous saliva, and is thus rendered more adhesive. By this means it is supposed to be the more readily and securely attached to its selected site. But if so, it would hardly appear, judging from their usual crumbling nature and the frequency with which, at the lightest touch, they fall to pieces, to be resorted to after the first few layers have been arranged, or certainly sparingly. Mr. Nuttall, in the introduction to his work on the Ornithology of the United States and Canada, speaks of the Cliff Swallow as "concealing its warm and feathered nest in a receptacle of agglutinated mud resembling a narrow-necked purse or retort." A person who had never seen these nests would receive from this an exaggerated idea of the adhesive nature of the external nest, as well as of its internal construction. Feathers are by no means its universal, or even general, lining. While they are often found intermixed with coarser materials, the nest is as often found without as with them. A well-informed and accurate observer, Mr. C. S. Paine, of Randolph, Vermont, writes me in reference to these birds: "They are very common here, and congregate in large communities. A neighbor has a barn with more than a hundred nests under its eaves. They have built there a good many years. A few years ago I spent several weeks in Illinois, on Rock River. I found these Swallows in great abundance there. They built their nests on the face of the rocks that line the river. In one place there were at least five hundred nests. The birds would come and go from them like bees from a hive. I frightened them from their nests, and they accumulated in a perfect cloud over my head."

I have several times seen a settlement disturbed in this manner. It is a very striking sight. The whole colony form into what is well called a cloud, sail over your head in rapid circles, with a combination of sharp outcries and sounds perfectly indescribable. If in the height of the breeding season, and any have young, their agitation is greatly increased, and they will even manifest a disposition to attack you as you approach the nests, fly close to your head, with sharp, angry cries, and make a snapping or clicking sound with their bills.

The eggs of this Swallow exhibit greater variations in markings, size, and shape than are usual with birds of this family, as the variations in the accompanying figures may attest. They may usually be distinguished from those of the Barn Swallow by their coarser spots, the less elongated shape of the egg, and the browner color of the markings. It is, however, frequently very difficult to distinguish them. The ground color of the egg is white; the spots vary in number, size, shade, and distribution, but are usually reddish-brown, and scattered over the whole egg. The following are their several measurements: greatest length, $\frac{7}{8}$ of an inch; least length, $\frac{6}{8}$; average length, $\frac{1}{1}\frac{3}{6}$; greatest breadth, $\frac{5}{8}$ of an inch; least breadth, $\frac{9}{1}\frac{}{6}$; average breadth, $\frac{1}{3}\frac{9}{2}$.

HIRUNDO BICOLOR.

Hirundo bicolor, Vieill. Ois. d'Am. Sept. I, 1807, 61, pl. xxxi.
" " Bonap. Syn. 1828, p. 65.
" " Rich. & Swains. F. B. A. II, 1831, 328.
" " Aud. Am. Biog. I, 1832, 491 ; V, 417 ; pl. xcviii.
" " Nuttall, Manual, I, 1832, 605.
" " Aud. Syn. 1839, p. 35.
" " " Birds of Am. I, 1840, 175, pl. xlvi.
" " De Kay, Nat. Hist. N. Y., Birds, 1844, pl. xxix, fig. 1.
" " Lembeye, Aves de la Isla de Cuba, 1850, p. 46.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 244.
Hirundo viridis, Wilson, Am. Orn. V, 1812, 44, pl. xxxviii, fig. 3.
" " Sabine, Franklin's Journ. p. 679.
" " Aud. Ann. Lyc. Nat. Hist. of N. Y. I, 1824, 166.
Hirundo leucogaster, Stephens, Gen. Zoöl. X, 1817, 106.
Chelidon bicolor, Bonap. Geog. and Comp. List, 1838, p. 8.
Vulg. — *Green and Blue Swallow. White-bellied Swallow. The Martin* (about Boston). *Stump Swallow. Wood Swallow. White Martin. Golondrina verdosa.*

In the habits of different individuals of this species we find presented, in remarkable contrast, a strict adherence to its primitive breeding peculiarities in certain localities, and a complete departure from them in others. In the more thinly settled portions of the country, especially where old forests with their many hollow trees and decayed stumps are still abundant, we find this Swallow breeding in their convenient cavities, and seldom induced, even when the effort is made to tempt them to do so, to occupy the boxes put up for their better accommodation. This was the case in the cluster of small islands in the Bay of Fundy around Grand Menan, where these birds are very abundant, and where, although martin-boxes had been prepared for their use, in no instance had they, when I last visited that locality (1851), been induced to occupy them. Hollow trees, holes in stumps, fences, and logs seemed to be their preferred places for nesting. They are in consequence known in such localities by the name of the Wood Swallow. So also, in the western part of the country, hollow trees are so generally their resort, that even Audubon, at the time of the publication of the first volume of his Ornithological Biography, was not aware that they had, in any instances, been known to imitate the Blue-Bird, the Martin, and the Wren, in accepting the hospitalities of man. Yet this fact had not escaped the observation of Wilson. In some parts of the country, especially in Eastern Massachusetts, these Swallows have undergone a change of habit as complete as that of the Purple Martin, of whose boxes they have there possessed themselves. I have even known of their nesting in a rough candle-box with one end knocked out, and placed for them in an accessible situation. Mr. Audubon speaks of their driving the Barn Swallow from its nest and taking possession, and Nuttall mentions their breeding on flat horizontal branches of trees. I have never met with them in either of these situations.

This species is widely distributed, from the Middle States to the extreme northern

regions. Sir John Richardson found them breeding in hollow trees at Fort Norman, on the Mackenzie River, in latitude 65°. They are spoken of by writers as not so numerous as the Barn Swallow; but this my own observations would lead me to doubt. Along the Atlantic coast, from latitude 38° to the St. Lawrence, they are our most common species. They are said to be equally abundant on the shores of the Pacific and the banks of the Columbia River. They seem to be less abundant in the interior, especially in the absence of water.

If, as we presume to be the case, the species of the Pacific coast is identical with this, the White-bellied Swallow has a range coextensive with the habitable portions of North America, from the West India Islands to Greenland, on the Atlantic, and from Southern California to the Russian possessions, on the Western coast. Dr. Townsend observed it throughout Oregon; Dr. Gambel, Dr. Heermann, and Mr. Samuels met with it breeding in California; Lembeye and Gundlach give it as one of the common birds of Cuba (though not mentioned by Mr. Gosse as found in Jamaica); and Dr. Woodhouse found it throughout the Indian Territories, Texas, and New Mexico, as well as in California.

This species, during the breeding season, is more quarrelsome than any other of their relatives, and are quite a match even for the Purple Martin, upon whose premises they often intrude and keep possession. They evince a strong attachment to their offspring, and manifest great affliction when robbed of them, uttering low but exceedingly plaintive complaints. When a pair of these Swallows have become familiarized to a certain locality, returning to it year after year, with a little pains it is not difficult to enter into a limited intercourse with them, especially in supplying them with the materials of their nest. Two of these birds, who have for several years occupied an old and rudely-constructed tenement in the very heart of Boston, receive each year an abundant supply of feathers, almost from the very hands of the members of the family under whose protection they find a shelter. Nearly all the materials they used were feathers blown to them from the window, which with the quickness of thought they would dart at and catch with their bills, and immediately convey to their retreat. In time they became so familiar, as almost to take them from the hands of the person who supplied them. This has been repeated several seasons. When they have young just hatched, or eggs on the point of hatching, they sit so close as to be easily taken on their nest. When taken and released, they fly but a few feet from their nest, hovering over the heads of the intruders.

They construct a very loose, soft, warm nest of fine hay and leaves, abundantly supplied with down and soft feathers, by which the eggs are often found completely covered. Great pains are apparently taken to keep the nest clean and dry by constant additions of soft, dry materials during incubation. They have usually two broods in a season.

Their eggs are of a beautifully pure white. When unblown, they have a delicate pinkish shade, imparted by the yolk. They are somewhat oblong in shape, the smaller ends are well defined and pointed, and the eggs are only subject to occasional variations in size. Their measurements vary from $\frac{12}{16}$ to $\frac{14}{16}$ of an inch in length, and from $\frac{8}{16}$ to $\frac{9}{16}$ in breadth.

HIRUNDO THALASSINA.

Hirundo thalassina, Swains. Syn. Mexican Birds, Philos. Mag. 1827, p. 366.
" " Aud. Orn. Biog. IV, 1835, 497, pl. ccclxxxv, figs. 4 and 5.
" " Bonap. Geog. and Comp. List, 1838, p. 9.
" " Aud. Syn. 1839, p. 36.
" " " Birds of Am. I, 1840, 186, pl. xlix.
Vulg. — *The Violet-Green Swallow.*

The first knowledge I possessed of the markings of the egg of this species was supplied me by Mr. Audubon, in the drawing of an egg obtained by Mr. Nuttall in Oregon. But a very limited knowledge is as yet in our possession in regard to its habits, its distribution, or general peculiarities. For nearly all that we do know, we are indebted to the observations of Messrs. Townsend and Nuttall. The latter met with this Swallow on a branch of the Colorado. They were in great numbers, associating with the Cliff Swallow. He states that they occupied the old nests of the latter, in preference to constructing their own. He also conjectured, probably without good reason, that they breed in trees, after the manner of the White-bellied Swallow.

Mr. Townsend's account of this Swallow differs materially. He also speaks of finding them breeding on the banks of the Colorado, where, he adds, it nests along its margin on bluffs of clay, to which it attaches a nest formed of mud and grasses resembling that of the Cliff Swallow, but wanting the pendulous neck. It is quite probable that the nests supposed by Mr. Nuttall to be old nests of *H. lunifrons* were in reality constructed by this species for their own use. Mr. Townsend speaks of the eggs as having been four in number, and of a dark clay-color, with a few spots of reddish-brown at the larger end. This hardly corresponds with the drawing of the egg obtained by Mr. Nuttall, nor yet with the one represented in the plate. Mr. Townsend adds, that it is also abundant on the Columbia River, and that it there breeds in hollow trees. He does not say whether this is the result of his own observations, or is given on the authority of others.[1]

The ground color of the egg of this bird, as given in the painting by Mr. Audubon, is a light stone-color, or clayish-white, — not a "dark clay-color," as Townsend describes it; and the spots, which are of varying light and dark shades of reddish and purplish brown, are scattered over the whole egg, instead of being confined to the larger end. Its shape is sub-oval, and more than usually oblong. It measures $\frac{2}{3}\frac{3}{2}$ of an inch in length by $\frac{7}{16}$ in breadth. The egg represented (Plate V, fig. 74) was obtained by Dr. Thomas H. Webb when engaged on the Mexican boundary survey. The nest is described by him as built on the side of a cliff, open at the top, and resembling the nest of the common *Hirundo rufa*. He obtained it on the bank of Mulberry River, near Mimbres, New Mexico. It measures $\frac{1}{1}\frac{3}{6}$ of an inch in length by $\frac{8}{16}$ in its greatest breadth. Its shape is an oblong oval, pointed at

[1] Dr. Cooper corroborates this statement as within his own experience.

one end. The ground color is white, with a few sub-markings of a grayish color, but without any of the usual shadings of purple. It is spotted, chiefly at the larger end, with scattered markings of a burnt terra-sienna color.

PROGNE PURPUREA.

Hirundo purpurea, Linn. Syst. Nat. I, 1766, 344.
" " Wilson, Am. Orn. V, 1812, 58, pl. xxxix, figs. 2 and 3.
" " Bonap. Syn. 1828, p. 64.
" " Sabine, Franklin's Journ. p. 678.
" " Rich. & Swains. F. B. A. II, 1831, 335.
" " Aud. Orn. Biog. I, 1832, 115; V, 408; pl. xxii.
" " Nuttall, Manual, I, 1832, 598.
" " " " II, 1834, 608.
" " Aud. Syn. 1839, p. 34.
" " " Birds of Am. I, 1840, 170, pl. xlv.
" " De Kay, Nat. Hist. N. Y., Birds, 1844, pl. xxviii, fig. 61.
Hirundo violacea, Gmelin, Syst. Nat. I, 1788, 1026.
Hirundo cærulea, Vieill. Ois. d'Am. Sept. I, 1807, 57, pls. xxvi and xxvii.
Hirundo versicolor, Vieill. Nouv. Dict. XIV, 1817, 309.
Hirundo ludoviciana, Cuvier, Reg. An. I, 1817, 374.
Progne purpurea, Bonap. Geog. and Comp. List, 1838, p. 8.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 245.

Vulg. — *The Martin. The Purple Martin. The House Martin. Great American Martin* (Edwards). *Purple Swift* (Pennant). *Sashun-peeshew* (Cree Indians). *Hirondelle bleu de la Caroline* (Buffon).

The introduction of the modes and customs of civilized life, and provident attentions to their wants and conveniences, have induced in the Purple Martin yet another instance of total change from natural habits in the breeding season. Social, familiar, and confiding, they have become general favorites, and, in return for obligations conferred upon man by keeping far off other and more dreaded feathered intruders and depredators, receive from him many favors. Comfortable, convenient, and safe dwellings, adapted to their wants, tempt them to rear their young in the society of their protectors and friends, no longer seeking for that purpose the holes of hollow trees. This change has become quite universal. Martin-boxes abound throughout the country. Even the Indians and Southern slaves are said to tempt them around their cabins by suspending hollow gourds and calabashes from saplings and cane-poles, and in these rude cradles they construct their nests. Audubon mentions an instance of a pair of Martins driven from the eaves of a house, where they had been in the habit of nesting, on account of the vermin they brought with them, who, having no convenient place to build in, resumed their natural resort, a hollow

tree. The following season, a martin-house was prepared for them, of which they immediately took possession.

During the breeding season, the Purple Martin is one of the most widely diffused of North American birds. It is found throughout the Union, in every State, from Louisiana to the Canadas. It was met with by Mr. Harris as far to the westward as the mouth of the Yellowstone River. It even extends its migrations to the extreme verge of Northern civilization. Sir John Richardson speaks of it as arriving within the Arctic Circle earlier than the others of its tribe. It makes its first appearance about Great Bear Lake as early as the 17th of May, when the ground is covered with snow, and the rivers and lakes are ice-bound. Dr. Woodhouse found it abundant in Texas and the Indian Territory, Dr. Townsend in Oregon, and Mr. Lembeye and Dr. Gundlach give it as a common bird in Cuba. It is found in every one of the United States, unless in California its place is occupied exclusively by its relative, *Progne chalybea*, and that species has been mistaken for it.

In the Southern States it raises three broods in a season; in its more northern resorts, the shortness of the season permits but one. In the maritime portion of Massachusetts, the Martins are less numerous now than formerly, though still abundant in the interior. This is attributable to the destruction of a large number of these birds, several years since, by an unusually cold and inclement season, in which both old and young suffered alike. But few escaped. It is probable their empty boxes would all have been reoccupied by new-comers ere this, had not the White-bellied Swallows of the neighborhood availed themselves of the occasion to desert their hollow trees and take possession of the vacant martin-boxes. These they have never since relinquished. The early migrations of the Martins expose them to frequent suffering, and even destruction, from unfavorable changes in the weather, as, notwithstanding the high parallels to which they penetrate, they do not appear to be a hardy bird.

The Purple Martin prepares a loosely-arranged nest, which is composed of various materials, such as fine leaves both dry and green, straw, hay, slender twigs, pieces of cloth, rags, &c. The whole is warmly lined with feathers and other soft materials. Each year it is repaired or reconstructed, with material additions, until successive seasons gather quite an accumulation. The eggs are uniform in color and shape, and do not vary much in size. They are rather small in proportion to the size of the bird. Their color is a pure cream-white, without spots. One end is much smaller and more pointed than the other. Their average measurements are $\frac{15}{16}$ of an inch in length by $\frac{11}{16}$ in their greatest breadth.

COTYLE RIPARIA.

Hirundo riparia, Linn. Syst. Nat. I, 1766, 344.
" " Gmelin, Syst. Nat. I, 1788, 1019.
" " Wilson, Am. Orn. V, 1812, pl. xxxviii, fig. 4.
" " Temminck, Manuel d'Ornithologie, I, 1820, 429; III, 300.
" " Bonap. Syn. 1828, p. 65.
" " Rennie, Montagu's Ornithological Dict. 1831, p. 17.
" " Rich. & Swains. F. B. A. II, 1831, 333.
" " Nuttall, Manual, I, 1832, 607.
" " Aud. Orn. Biog. IV, 1835, 584, pl. ccclxxxv.
" " " Syn. 1839, p. 36.
" " " Birds of Am. I, 1840, 187, pl. l.
" " De Kay, Nat. Hist. N. Y., Birds, pl. xxviii, fig. 62.
" " Lembeye, Aves de la Isla de Cuba, 1850, p. 47.
Hirundo cinerea, Vieill. Nouv. Dict. XIV, 1817, 526.
Cotyle riparia, Bonap. Geog. and Comp. List, 1838, p. 9.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 247.

Vulg. — *Bank Swallow. Sand Martin. Hirondelle de Rivage. Sand Swallow. Shee-shee-winae-paeshoo* (Cree Indians). *Golondrina Ribariega* (Cuba).

The common Bank Swallow of this country is still supposed to be the same with the European species. This identity has been carefully examined by Mr. Cassin, who unhesitatingly expresses the opinion that they are absolutely identical. It seems never to have been seriously doubted. It appears, therefore, no longer probable that closer investigations can demonstrate sufficient specific differences to justify a separation. Be this as it may, however, no perceptible variations are observable in the habits, mode of breeding, nesting, or eggs of the birds of either continent.

The American representatives of this species are found throughout the United States, from the Atlantic to the shores of the Pacific, as well as from the extreme southern States to the farthest northern limits. As, however, it has most probably been confounded in some places with the Rough-winged species, as it is still liable to be, without a close inspection, it may well be doubted whether full reliance can be placed upon all the accounts we have of its extended distribution. Certain it is, that, in the parts of the country where the Rough-wing is known to abound, this bird, if met with at all, is not common. Edward Harris, Esq. found the *serripennis* in the region of the Upper Missouri and the Yellowstone, but not this species. It seems not improbable, therefore, that a more careful investigation into the distribution of these two birds may show a more exclusively northern habitat for the Bank Swallow, while the Rough-wing may be found to be chiefly a denizen of the States south and west of Pennsylvania. The northern migrations of the Bank Swallow appear to be limited only by the extent of land for it to occupy. It is among the most northern of the land birds. Richardson found them breeding by thousands at the mouth of Mackenzie's River, in the sixty-eighth parallel of latitude. They are of course a very hardy bird, migrating to the north quite early in spring, when they

are often exposed to great inclemencies of weather, from which they take refuge in their holes.

They are a very social species, almost always breeding together in large communities, of hundreds, and even of thousands. They seem more independent of man than many of their kindred genera, only availing themselves of the incidental aid they may derive from excavations through sand-banks, opening convenient situations for their nests. These they construct in holes in the sides of banks, or cliffs, of sand, soft earth, and even of gravel, wherever the passage of a stream of water, the washing of waves, excavations for canals or railroads, or any similar exposure of convenient sites, afford them opportunities. These holes are usually as near the surface of the ground as the yielding nature of the soil will permit it to be readily penetrated, — generally from two to five feet. They extend to a depth of from three to four feet, — seldom less than two, or more than four. Their diameter is from three to four inches. In excavating such long channels to their nests, these little birds exhibit a remarkable industry and perseverance. After selecting the place, both sexes work alternately at the task, which usually occupies them four days of constant labor. The extremity of the passage is widened into a small chamber, the floor of which is warmly carpeted with fine dry grass, and soft, downy feathers. Upon this they deposit five beautiful crystal-white eggs. When recently deposited and unblown, the yolk, seen through the semi-transparent shell, imparts to it a delicate roseate shade. The eggs vary considerably in size and shape. Their length is from $\frac{11}{16}$ to $\frac{12}{16}$ of an inch, the average $\frac{23}{32}$. Their breadth also varies from $\frac{1}{2}$ to $\frac{7}{16}$ of an inch. In shape they are often as nearly oval as the eggs of the Swift, but generally one end is much more pointed than the other.

In regard to its geographical distribution, but little needs to be said. It is probably found throughout North America, from Cuba, where both Mr. Lembeye and Dr. Gundlach speak of it as common, to the mouth of Mackenzie's River, latitude 68° north. If identical with the Sand Martin of Europe, &c., it is found in all the four quarters of the globe. It is as abundant on the Pacific as on the Atlantic, and, according to Sir John Richardson, is as common in the Arctic regions as in the more temperate.

COTYLE SERRIPENNIS.

Hirundo serripennis, Aud. Orn. Biog. IV, 1835, 593.
" " " Syn. 1839, p. 37.
" " " Birds of Am. I, 1840, 193, pl. li.
Cotyle serripennis, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 247.
Vulg. — *The Rough-winged Swallow.*

Much yet remains to be learned of the habits and geographical distribution of this species; so closely resembling the Bank Swallow in many respects as to be liable

to be confounded with it, though readily distinguishable from it by careful observations. It is difficult, if not impossible, now to say how much of the history of that bird has had reference to this species. My own observations in regard to it have been confined to the neighborhood of Carlisle, Penn., the only place in which I have ever met with it, or where, to my certain knowledge, it has been ascertained to breed. They have also been seen in Louisiana, — where they were first discovered by Audubon, — Florida, Missouri, and Virginia, and were found by Dr. Heermann in California. They probably breed in each of these States, especially the last two, where they have been noticed in the breeding season. My friend, Professor Baird, then of Carlisle, found them breeding in that vicinity in the summer of 1843. Visiting that locality early in June, the following year, I had an opportunity to observe their habits in the breeding season, in company with that accurate ornithologist. We found it quite common, and examined a number of nests. It is worthy of remark, that none of those we found that season were in places excavated by the bird, although Professor Baird informs me he has known them to nest in holes apparently prepared in the same manner as those of the Bank Swallow. All the nests I have ever seen were in situations accidentally suited to their wants, and all were directly over running water. We found seven nests, all of which were in similar situations. This may not be enough to be decisive of this reliance upon accidental aids, or rather of its universality, but certainly shows it to be at least very common. Several were constructed in crevices between the stones in the walls and arches of bridges. In numerous instances the nests were but little above the surface of the stream. One had been flooded by the rise of the water, and the eggs addled. Instead of forsaking the locality, the birds had constructed another nest directly over the first. In this double nest we found twelve eggs, six of which were quite fresh, and all had been deposited that season. Another nest was constructed between the stones of a wall which formed one of the sides of the flume of a mill. Along the top of this wall was a frequented footpath, while the water of the mill-stream was not two feet below it. One nest was found in a somewhat higher situation, between the boards covering a small building containing a water-wheel. The entrance to the nest was through a knot-hole in the outer partition, and it was placed upon a small rafter between the outer and inner partitions.

The nest, very similar in its construction to that of the Bank Swallow, is composed of dry grass, straw, and leaves, loosely put together, and lined with downy feathers. Owing, perhaps, to the exposed situations in which we found them, and their danger of being flooded by a rise of the stream, a much greater amount of material was used in their construction than by the Bank Swallow. In other respects there was no apparent difference.

Nor are their eggs readily distinguishable from those of that species, being nearly uniform with them in size, shape, and color. They are pure white, perhaps a little more uniformly oblong, and usually quite pointed at the smaller end. They vary in size from $\frac{1}{1}\frac{1}{6}$ of an inch in length to $\frac{2}{3}\frac{5}{2}$, and in breadth from $\frac{1}{2}$ to $\frac{9}{1}\frac{}{6}$ of an inch. The average length is $\frac{1}{1}\frac{2}{6}$ and the average breadth $\frac{1}{3}\frac{7}{2}$ of an inch.

CYPSELINÆ.

ACANTHYLIS PELASGIA.

Hirundo pelasgia, Linn. Syst. Nat. I, 1766, 345.
" " Wils. Am. Orn. V, 1812, 48.
" " Vieill. Ois d'Am. Sept. I, 1807, 73.
Hirundo cerdo, Bartram, Trav. 1791, p. 292.
Hirundo carolinensis, Brisson, II, 501.
Cypselus pelasgius, Bonap. Syn. 1828, p. 63.
" " Nuttall, Manual, I, 1832, 609.
" " Aud. Orn. Biog. II, 1835, 329; V, 319; pl. clviii.
" " De Kay, Nat. Hist. N. Y., Birds, 1844, pl. xxvii, fig. 58.
Chætura pelasgia, Bonap. Geog. and Comp. List, 1838, p. 8.
" " Aud. Syn. 1839, p. 33.
" " " Birds of Am. I, 1840, 164, pl. xliv.
Cypselus acutus, Bonap. Consp. Av. p. 64.
Acanthylis pelasgia, Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 249.
Vulg. — *The Chimney Swallow. The American Swift. Chimney Swift. Aculeated Swallow* (Arc. Zoöl.). *American Spine-tail.*

The Swift, or, as it is more generally called, Chimney Swallow, of North America, in its habits during the breeding season presents a remarkable contrast to the European species. While the latter are shy and retiring, shunning the places frequented by man, and breeding chiefly in caves or ruined and deserted habitations, their American representatives, like most of the Swallow family here, have at once upon the erection of the dwellings of civilized life manifested their appreciation of the protection they afford, by an entire change in their habits in respect to the location of their nests. When the country was first settled, these birds were known to breed only in the hollow trunks of forest-trees. The chimneys of the dwellings of civilized communities presented sufficient inducements, in their superior safety and convenience, to tempt them to forsake for them their primitive breeding-places. So complete has been the change in this respect, that, wherever the country has been long settled, they are hardly known to resort to hollow trees for any other purpose than as occasional roosting-places. It is not impossible that hereafter, when this change of habit shall have become universal, and there are no longer any of the species left to furnish an example of their primitive mode of nesting, it may become a disputed point among naturalists whether they ever did nest in hollow trees, as there are already those who dispute the more extended immigrations of the Cliff Swallow, now that they have become so common in the eastern part of the continent. Even at the present day, in some portions of the country, so universally do they deserve their name, that few realize that chimneys have not always been their natural breeding-places.

The Chimney Swallow is known to breed throughout the central and northern States, from Virginia almost to Labrador, and the recent explorations show that they are found from ocean to ocean. They have been observed in abundance on the

eastern slope of the Rocky Mountains, and are also found in nearly equal numbers along the shores of the Pacific. Sir John Richardson did not meet with them in the Arctic regions. Dr. Woodhouse speaks of having found the Chimney Swallow very common throughout the Indian Territory, Texas, New Mexico, and California.

The nest of the Chimney Swallow is one of the most remarkable structures of the kind to be found among the handiworks of even this interesting family, nearly all of whom are far from being undistinguished for their architectural accomplishments. It is composed of small twigs of nearly uniform size, which are interwoven into a neat semicircular basket. In selecting the twigs with which to construct the nest, the Swift seems to prefer to break from the tree such as are best adapted to its wants, rather than to gather those already scattered upon the ground. This is done, with great skill and adroitness, while on the wing. Sweeping on the coveted twig, somewhat as a Hawk rushes on its prey, it parts it at the desired place, and bears it off to its nest. This fact is familiar to all who have attentively observed their habits. Each of these twigs is strongly fastened to its fellows by an adhesive saliva secreted by the bird, and the whole structure is as strongly cemented to the side of the chimney in which it is built, by means of the same secretion. When dry, this saliva hardens into a glue-like substance, apparently firmer even than the twigs themselves. In separating a nest from the side of a chimney, I have known portions of the brick to which it was fastened to give way sooner than the cement with which it had been secured. When moistened, however, by long or heavy rains, the weight of their contents will sometimes cause them to part, and precipitate the whole to the bottom. The young birds cling very tenaciously to the sides of the chimneys, with their strong claws and muscular feet, and often save themselves from falling, in such accidents, by these means, even at a very early age, and before they have attained their sight. As the nest, even when undisturbed, soon becomes too small for them, the young leave it, long before they are able to fly, and climb to the top of the chimney, where they are fed by their parents.

The eggs are usually four in number. This I have never known them to exceed, although Audubon speaks of their having six. They are pure white, and unspotted. They vary but little in size, which is small for that of the bird, or in shape, which is slightly elliptical. The eggs are from $\frac{3}{4}$ to $\frac{1}{1}\frac{3}{6}$ of an inch in length, and from $\frac{1}{2}$ to $\frac{9}{1}\frac{}{6}$ in breadth. One end is somewhat smaller, as well as more pointed, than the other, but the difference is not so marked as in the eggs of most of the family *Hirundinidæ*, while they are much less elliptical than the eggs of the *Caprimulgidæ*.

Under favorable circumstances, the Chimney Swift raises two broods in a season.

In its semi-nocturnal habits, the Chimney Swallow resembles the Night-Hawk more than the Swallow. They are to be seen abroad more frequently in the morning or evening twilight than in the middle of the day. When they have young, they are busy feeding them during the greater portion of the night. They are not, however, strictly nocturnal, but may be frequently met with abroad at midday, even when the sky is unclouded.

Family HALCYONIDÆ.

CERYLE ALCYON.

Alcedo alcyon, Linn. Syst. Nat. I, 1766, 180.
" " Wils. Am. Orn. III, 1812, 59.
" " Bonap. Syn. 1828, p. 48.
" " Rich. & Swains. F. B. A, II, 1831, 339.
" " Nuttall, Manual, I, 1832, 594.
" " Aud. Orn. Biog. I, 1832, 394; V, 548.
" " Nuttall, Manual, II, 1834, 609.
" " Aud. Syn. 1839, p. 173.
" " " Birds of Am. IV, 1842, 205, pl. eclv.
" " Lembeye, Aves de la Isla de Cuba, 1850, p. 131.
Ispida ludoviciana, Gmelin, Syst. Nat. I, 1788, 452.
Alcedo jagnacati, Dumont, Dict. Sci. Nat. I, 1816, 455.
Alcedo gnacu, Vieill. Nouv. Diet. XIX, 1817, 406.
Ceryle alcyon, Bonap. Geog. and Comp. List, 1838, p. 10.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 354.

Vulg. — *The Belted Kingfisher. Okees-kae-mannaeshew* (Cree Indians). *Martin Peseador* (Cuba).

This species is widely distributed, — in the breeding season throughout nearly the whole North American continent. During the winter months it is found in several of the more southern States. As soon as the ice has melted from northern ponds and streams, it is diffused over nearly the entire Union. According to Richardson, it frequents all the large rivers of the Fur countries up to the sixty-seventh parallel. Townsend met with it along the Missouri and Columbia rivers, and Audubon found it in all the States from Texas to Labrador. Mr. Harris did not, however, meet with it on the Yellowstone, nor did Captain Stansbury in his expedition to the Great Salt Lake and Utah. It is probable that but few, if any, remain to breed in the extreme southern States, although they may be met with there quite abundantly from September to April.

It is not a social bird, living only in solitary pairs. It frequents the vicinity of running water, and nests in holes in the banks of rivers, which it excavates with much toil and labor. The place selected for this purpose is usually near a waterfall or rapid, and if the stream has been made available for a mill, it is quite common to find them nesting near the dam. They usually select for the hole a dry place, just enough above the water to be out of the reach of a freshet. It is often dug through hard gravel to the depth of several feet, and is not always near water.[1]

[1] One of the most remarkable instances of the Kingfisher's nesting at a distance from water was observed at the White Mountains in the spring of 1855. By the side of the carriage path then partially constructed on Mount Washington, I found a Kingfisher's hole, nearly a mile distant from the Peabody River, or any other stream of water.

It is usually from four to six feet in depth, and about four inches in diameter, slightly narrowing as it recedes, but again widening at the termination, where it is expanded into a snug little arched chamber, large enough for the whole family to turn round in with ease. The bottom is covered with matted twigs, straw, and feathers. The eggs are six in number, and of a beautifully pure crystal whiteness. They are nearly uniform in size and shape, the latter being very nearly spherical. The average measurement of the eggs is $1\frac{5}{16}$ inches in length, and $1\frac{1}{16}$ in breadth. This is slightly larger than that given by Audubon, but corresponds with my own observations.

The excavation of the hole in which they nest, though a work of much labor, is not so difficult as might be supposed without examining the peculiar adaptation of the bird to its accomplishment. Its wedge-shaped body, powerful and pointed beak, and short muscular feet admirably suit it for burrowing, even in the hardest soil. Its short powerful tarsus, the broad flat palm into which its toes are united, with its strong, short, and sharp claws, combine to adapt its feet to form most efficient co-workers with its beak in digging out the home to which, after it has once made it, it perseveringly adheres in spite even of frequent molestations. The Kingfisher is devoted to its offspring, and exhibits great solicitude if their safety is threatened. I have known the female suffer herself to be repeatedly taken from her nest rather than desert her young, and Mr. Audubon speaks of their resorting to ingenious stratagems to draw off intruders.

CERYLE AMERICANA.

Alcedo americana, Gmelin, Syst. Nat. I, 1788, 451.
Alcedo viridis, Vieill. Nouv. Dict. XIX, 1818, 413.
Ceryle americana, Lawrence, Ann. Lyc. Nat. Hist. of N. Y. V, 1851, 118.
" " Cassin, Syn. N. A. Birds (Illust. Birds of Cal.), 1854, p. 255.
Vulg. — *The Texan Green Kingfisher.*

The egg represented in the plate was found in the collection of Dr. Berlandier, now in the possession of the Smithsonian Institution, designated as that of a Kingfisher, but with no description accompanying it of the parent bird to which it belonged. Its size, however, sufficiently shows the species, if, as we presume, it was correctly marked. This specimen resembles the eggs of the Belted Kingfisher in every respect except size. Its color is a pure bright crystal white. The egg measures an inch and a sixteenth in length by thirteen sixteenths of an inch in breadth.

Nothing is known, so far as I am aware, of the habits of this species. It is safe

to presume, however, that they do not essentially vary from those of the more common Kingfisher of the Northern States. It has been found throughout that portion of Texas that lies on the Rio Grande, and in nearly all parts of Mexico and portions of New Mexico. It has long been well known as a bird of South America. It has not been traced with certainty to the Pacific coast, but it is probable that it will be found to be a bird of Southern California.

ADDENDA.

Cathartes californianus. — In Newman's "Zoölogist" (Vol. XIII, p. 4633, 1855) occurs the following in reference to the eggs and nesting of the California Vulture. It is contributed by Mr. A. S. Taylor, of Monterey. I have given it with the view of putting on record all the statements and descriptions made public in this connection, though I do not think the account here given will be confirmed in all respects by more full and certain testimony. Mr. Taylor's information is, as may be seen, derived from the reports of others, and is therefore not so reliable as it would be if given from his own observations.

"The egg of the bird is three inches broad and five long, about one third longer than a goose's egg. Its color is a dirty pale blue, spotted brown, and it is nearly as thick as an ostrich's egg. The same person informs me, that the female lays only one egg during the season, and makes her nest on the ground in the ravines of the mountains, and generally near the roots of the red-wood and pine trees. It is three months before the young birds can fly."

Hypotriorchis femoralis. — Mr. Nathaniel H. Bishop, of Medford, Mass., has furnished me, since the preceding pages were in type, with the following additional facts relative to the history of the Hawk found by him on the Pampas, and called by the inhabitants the "Alcon."

"During my pedestrian tour across the continent of South America, I found the 'Alcon' to be a common resident of the Pampas, where it may be seen standing for hours in the grass, or circling in the air in search of food. Upon the Travesia, or Desert of San Luis, which lies between the Pampas and the Andes, like the Burrowing Owl, it is only occasionally met with, excepting about the farms in the vicinity of the mountains. During the winter, which along the eastern base of the Andes is very mild, the 'Alcons' resort to the wheat-fields and farm-yards, searching in the first-mentioned localities for mice and insects, and in the second for the refuse of the table, devouring cooked as well as raw meat. I do not recollect seeing them prey upon small birds; certainly the latter do not fear them, as it is no uncommon thing to see 'Alcons' and small birds upon the same bush. About San Juan, during the fall and winter months, these Hawks return singly at night to the same nesting-place, living in perfect harmony. I have seen as many as forty collected together,

night after night, upon a thorn-tree, while two yards distant a flock of larks (*Sturnella militaris*) roosted with unconcern. This is the tamest of any South American Hawk, and, as if courting the society of man, it builds its nest near the huts of the natives. The Gauchos say that the 'Alcon' never preys upon chickens; but while visiting a farmer near San Juan, I witnessed a fact showing the contrary. One of these Hawks descended into the yard and carried off a chick that could not have been less than two months old. In September and October they build their nests, and lay two eggs. The nest from which I procured the specimens I send you was built of small sticks, upon the top of a bush that overhung a canal of water, in the immediate vicinity of a mill. At first I took but one egg, which robbery did not seem to trouble the old birds, as they continued to sit upon the remaining one. Frequent visits to the spot did not alarm them, neither did traps placed upon the nest drive them from it; and after the second egg had been removed, they remained about the place as before."

Buteo swainsoni. — Since the preceding pages were printed, I have been informed by Dr. Heermann that I was in error in the statement that the egg of this species was procured by him in California. Dr. Heermann writes to Professor Baird in regard to it: "I procured it on the eastern slope of the Rocky Mountains, on the Sweet-Water, which goes through the South Pass mentioned by Fremont. There being no large trees bordering that stream, this Hawk had chosen a good-sized willow in which to construct its nest. Externally it was made up of large twigs, and lined with the inner bark of cotton-wood and some tufts of buffalo hair. The young had left the nest some time before, and I found a single egg, which was carefully preserved. The old birds and a young one were shot the same day, still frequenting the vicinity in which incubation had taken place. I do not recollect ever having seen this species in California."

Nauclerus furcatus. — Since the portion which relates to the Swallow-tailed Hawk has been printed, I have learned, by letter from Maxcy Gregg, Esq. of Columbia, South Carolina, some additional facts in regard to the geographical distribution of this Hawk, which appear worth giving. He informs me that it is a rare bird in the vicinity of Columbia, but thinks that it may be found breeding some ten or twenty miles below that place, on the Congaree. He also states, that at the confluence of the Ocmulgee and Oconee rivers, in Georgia, these birds are very numerous in the spring. He adds: "I may here mention, that I once in the end of July saw many of these Hawks sailing about near the top of the Balsam Mountain, — one of the loftiest and wildest mountains in North Carolina (about latitude 35° 15′ N., longitude 82° 50′ W.). I was told by a mountaineer, who was a great hunter and very observant, that they are seen in that vicinity every summer. The circumstance attracted my attention, because I had never seen the Swallow-tailed Hawk in any other part of the mountains, from South Carolina to Virginia, although I had rambled a good deal through that region."

Circus hudsonicus. — Mr. Peter Reid, of Lake P. O., Washington County, N. Y., communicates to the Smithsonian Institution the following observations in regard to the nesting of the Marsh Hawk. It should be stated, that they do not correspond with the facts noticed in connection with the eggs of this species obtained in Maine by Dr. Dixon. There was no difference noticed in the progress made in their incubation, or if there was any, it was slight, and escaped observation. Mr. Reid writes: "I have recently visited Fort Edward in this county, where the Marsh Hawks were extremely numerous last summer, and where there are some wintering at this time (February, 1857). My friend informed me that these Hawks nested in great numbers on the flats near the river. Three pairs nested in his cornfield, whose presence he regarded as so beneficial, that he avoided disturbing the nests. By working in close contact with them, the birds became quite tame, and he was enabled to observe with care their economy during the breeding period. He says that on the first egg or eggs being laid, one of the parent birds constantly occupies the nest, and at intervals of two or more days an additional egg is laid; and that in one of the nests he observed that the young that first appeared had left it before the exit of the last two from the eggs, whose age likewise differed some two or three days. His statements, sufficient of themselves to those who know the man, were corroborated by others. In the three nests referred to as found in his cornfield, there were eleven, twelve, and thirteen eggs." The largest number I have ever met with is six eggs in a nest.

Aquila chrysaetos. — This bird is not given by Dr. Heermann in his notes on the birds of California in the Journal of the Philadelphia Academy. I therefore inferred (see page 45) that it was not met with by him, or it would have been included. He writes that in this I was in error, and that he did see this species three distinct times, but always in the high mountainous portions of the country.

Haliætus pelagicus. — The Northern Sea-Eagle, the largest and most powerful of the family, is a native of the extreme northwestern coast of North America. It has been omitted in the preceding pages, as I was not aware that any description of the eggs had been published. Since then Mr. Cassin has given, in his interesting papers on the Ornithology of the United States and British and Russian America, the following translation of the account by Pallas of the nesting and eggs of this Eagle: —

"In the highest rocks overhanging the sea, this bird constructs a nest of two ells in diameter, composed of twigs of trees, gathered from a great distance, and strewed with grass in the centre, in which are one or two eggs, in form, magnitude, and whiteness very like those of a Swan. The young are hatched in the beginning of June, and have an entirely woolly covering. While Steller was cautiously looking at a nest from a precipice, the parent Eagles darted at him with such impetuosity as nearly to throw him headlong. The female having been wounded, both flew away, nor did they return to their nest for two days. But, as if lamenting, they often sat on an opposite precipice."

This Eagle has been found on the remote coasts of Russian North America, the

opposite shores of Asia, and the Japan Islands. Of its habits little is positively known, and the notices by Pallas, the Russian naturalist, are the only reliable ones that have been published. The account of the eggs quoted above is quite indefinite, and probably not exactly correct. The eggs of Swans, for the most part, are not white, and of a more elliptical shape than those of the Raptorial family.

Haliætus leucocephalus. — In a recent paper by Mr. Cassin, published in the "United States Magazine," New York, while speaking of the doubts existing among naturalists as to the reality of the Bird of Washington (*Haliætus washingtonii*), he mentions that, in his opinion, "there are two species of White-headed Eagles inhabiting the States on the Atlantic sea-board. They appear to be constantly different in size, and we are not without suspicion that one is the Northern and the other a Southern bird. The larger has the bill much shorter, and very much as represented in Mr. Audubon's plate of the Washington Eagle; and, in fact, is in all respects that bird, except that it has not the large scales in front of the tarsus continued without interruption to the toes, as represented in the plate to which we allude." If Mr. Cassin's conjectures should prove to be well founded, the egg represented in the plate may belong to the more southern species. I am informed by Dr. Heermann that it was obtained in Maryland, and not in California, as stated (page 52). It is marked on the shell, February, 1856.

Haliætus grœnlandicus. — In the preceding pages, the *Haliætus albicilla*, or Sea-Eagle of Europe, is given as a bird of Greenland, and therefore entitled to a place among North American species. Its claims to be so regarded would seem to be somewhat problematical, inasmuch as it is now stated by Mr. Cassin that there is a Sea-Eagle in Greenland not identical with the European variety. It is also distinct from the White-headed Eagle, which it closely resembles. It therefore remains to be ascertained whether the *H. albicilla* is entitled to a place in the North American Fauna, or whether the Greenland bird, *H. grœnlandicus*, is the sole occupant of that region.

CATALOGUE

OF THE

SPECIES OF BIRDS INHABITING AMERICA, NORTH OF MEXICO.

I. Order RAPTORES.

I. Family VULTURIDÆ.

Cathartes	Page.	Plate.	Figure.
aura	1	I	1, 2
atratus	4	I	3, 4
californianus	6	*	*
burrovianus	†	†	†

II. Family FALCONIDÆ.

FALCONINÆ.

Falco			
anatum	8	II	11
nigriceps	†	†	†
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EXPLANATION OF PLATES.

PLATE I.

Figure.	Species.	Collected by	Obtained in	In Cabinet of
1.	Cathartes aura,	John Bachman,	South Carolina,	T. M. Brewer.
2.	do.	Dr. C. Kollock,	Cheraw, S. C.,	do.
3.	Cathartes atratus,	J. J. Audubon,	Galveston, Tex.,	do.
4.	do.	Dr. C. Kollock,	Cheraw, S. C.,	do.
5.	Astur atricapillus,	Rufus K. Winslow,	Northern Ohio,	do.
6.	Buteo montanus,	E. Samuels,	California,	Smithsonian Institution.
7.	Buteo calurus,	do.	do.	do.
8.	Buteo pennsylvanicus.	John Krider,	New Jersey,	T. M. Brewer.
9.	do.	Dr. J. Trudeau,	Pennsylvania,	do.
10.	do.	Gustavus Wurdemann,	Florida,	Smithsonian Institution.

PLATE II.

11.	Falco anatum,	Uncertain,	Greenland,	T. M. Brewer.
12.	Hierofalco sacer,	do.	do.	Philadelphia Academy.
13.	Tinnunculus sparverius,	J. J. Audubon,	Nebraska,	T. M. Brewer.
14.	do.	T. M. Brewer,	Maryland,	do.
15.	do.	do.	do.	do.
15 *a*.	do.	A. Hopkins,	Massachusetts,	do.
16.	Buteo borealis,	Dr. Henry Wheatland,	do.	do.
17.	do.	C. S. Paine,	Vermont,	do.
17 *a*.	do.	Augustus Fowler,	Massachusetts,	A. Fowler.
18.	Polyborus tharus,	Dr. Berlandier,	Matamoras,	Smithsonian Institution.
19.	do.	do.	do.	do.
20.	Morphnus unicinctus,	do.	do.	do.
21.	do.	do.	do.	do.

PLATE III.

22.	Hypotriorchis femoralis,	N. H. Bishop,	Pampas, S. A.,	T. M. Brewer.
23.	Accipiter fuscus,	H. R. Storer,	Massachusetts,	do.
24.	do.	J. Krider,	New Jersey,	do.
25.	Buteo lineatus,	do.	do.	do.
26.	Archibuteo ferrugineus,	Dr. A. L. Heermann.	California,	Dr. A. L. Heermann.
27.	Buteo insignatus,	E. Samuels,	do.	Smithsonian Institution.
28.	Archibuteo sancti-johannis,	J. Krider,	New Jersey,	J. Krider.
29.	Archibuteo lagopus,	F. H. Storer,	Labrador,	F. H. Storer.
30.	Buteo swainsoni,	Dr. A. L. Heermann,	Rocky Mountains.	Dr. A. L. Heermann.

Figure.	Species.	Collected by	Obtained in	In Cabinet of
31.	Circus hudsonicus,	Dr. R. Dixon,	Maine,	T. M. Brewer.
32.	do.	do.	do.	do.
33.	Pandion carolinensis,	J. Krider,	New Jersey,	do.
34.	do.	do.	do.	do.
35.	Hypotriorchis columbarius,	T. M. Brewer,	Grand Menan,	do.

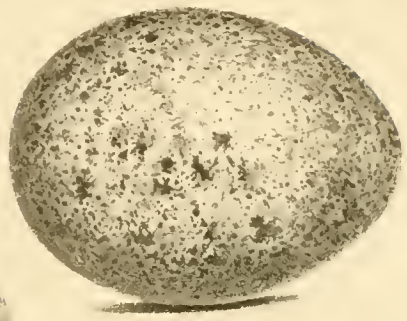
PLATE IV.

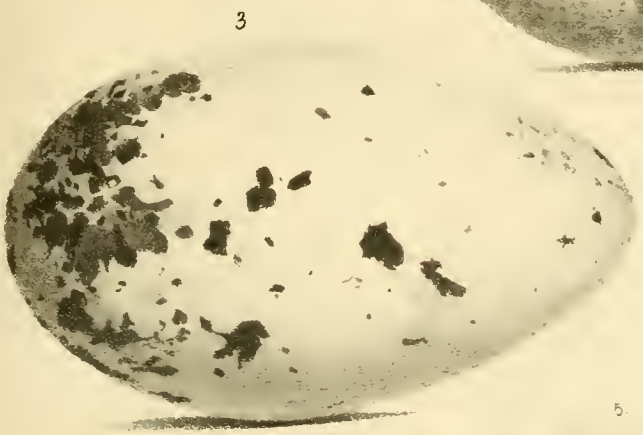
36.	Circus hudsonicus,	J. J. Audubon,	Louisiana,	T. M. Brewer.
37.	Haliætus leucocephalus,	Dr. A. L. Heermann,	Maryland,	Dr. A. L. Heermann.
38.	Strix pratincola,	J. H. Clark,	New Mexico,	Smithsonian Institution.
39.	Bubo virginianus,	Dr. Berlandier,	Matamoras,	do.
40.	Scops asio,	J. J. Audubon,	New York,	T. M. Brewer.
41.	Scops m'callii,	Dr. Berlandier,	Matamoras,	Smithsonian Institution.
42.	Otus wilsonianus,	A. Wilson,	New Jersey,	T. M. Brewer.
43.	Brachyotus cassinii,	J. Eliot Cabot,	Grand Menan,	do.
44.	Syrnium nebulosum,	William Hopkins,	New York,	do.
45.	Nyctale acadica,	Rufus K. Winslow,	Ohio,	do.
46.	Athene hypugœa,	E. S. Holden,	California,	do.
47.	Hirundo bicolor,	T. M. Brewer,	Massachusetts,	do.
48.	Progne purpurea,	Zadoc Thompson,	Vermont,	do.
49.	Cotyle riparia,	T. M. Brewer,	Massachusetts,	do.
50.	Cotyle serripennis,	do.	Pennsylvania,	do.
51.	Acanthylis pelasgius,	do.	Massachusetts,	do.
52.	Alcedo alcyon,	do.	New Hampshire,	do.
53.	Alcedo americana,	Dr. Berlandier,	Matamoras,	Smithsonian Institution.

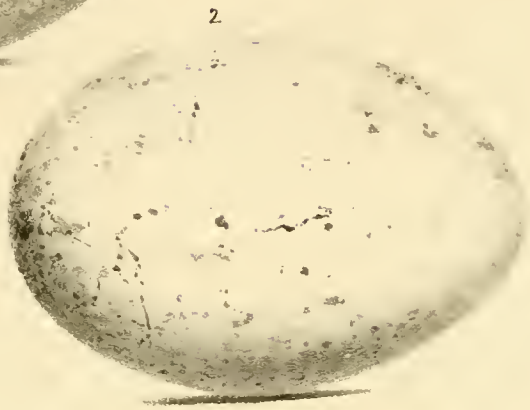
PLATE V.

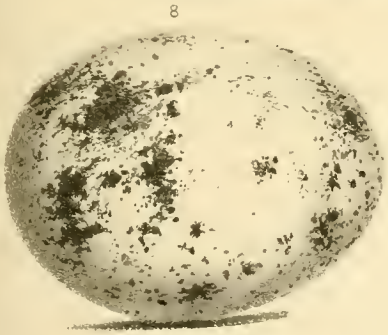
54.	Accipiter fuscus,	Dr. H. R. Storer,	Massachusetts.	T. M. Brewer.
55.	Accipiter cooperii,	A. D. Curtis,	South Carolina,	do.
56.	Antrostomus carolinensis,	Dr. H. Bryant,	Florida,	do.
57.	Antrostomus vociferus,	T. M. Brewer,	Massachusetts,	do.
58.	Antrostomus Nuttallii,	Dr. Berlandier,	Matamoras,	Smithsonian Institution.
59.	Chordeiles virginianus,	T. M. Brewer,	Massachusetts,	T. M. Brewer.
60.	do.	do.	New Hampshire,	do.
61.	do.	C. S. Paine,	Vermont,	do.
62.	Chordeiles texensis,	Dr. Berlandier,	Matamoras,	Smithsonian Institution.
63.	Hirundo rufa,	T. M. Brewer,	Massachusetts,	T. M. Brewer.
64.	do.	do.	do.	do.
65.	do.	do.	do.	do.
66.	do.	do.	do.	do.
67.	do.	do.	do.	do.
68.	Hirundo lunifrons,	do.	Pennsylvania,	do.
59.	do.	do.	Vermont,	do.
70.	do.	do.	Nova Scotia,	do.
71.	do.	do.	Massachusetts,	do.
72.	do.	do.	New Hampshire,	do.
73.	do.	do.	Maine,	do.
74.	Hirundo thalassina,	Dr. Webb,	New Mexico,	do.

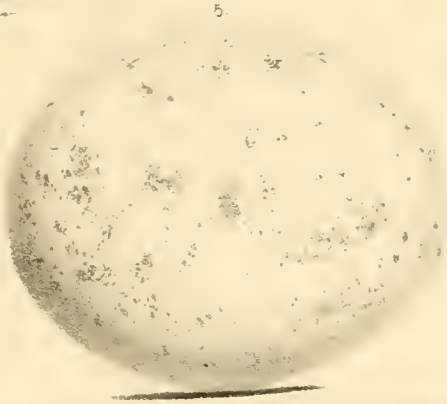
[PUBLISHED BY THE SMITHSONIAN INSTITUTION, JUNE, 1857.]











Otto Knirsch del

Bowen & Co Lith Phila

1, 2 CATHARTES AURA

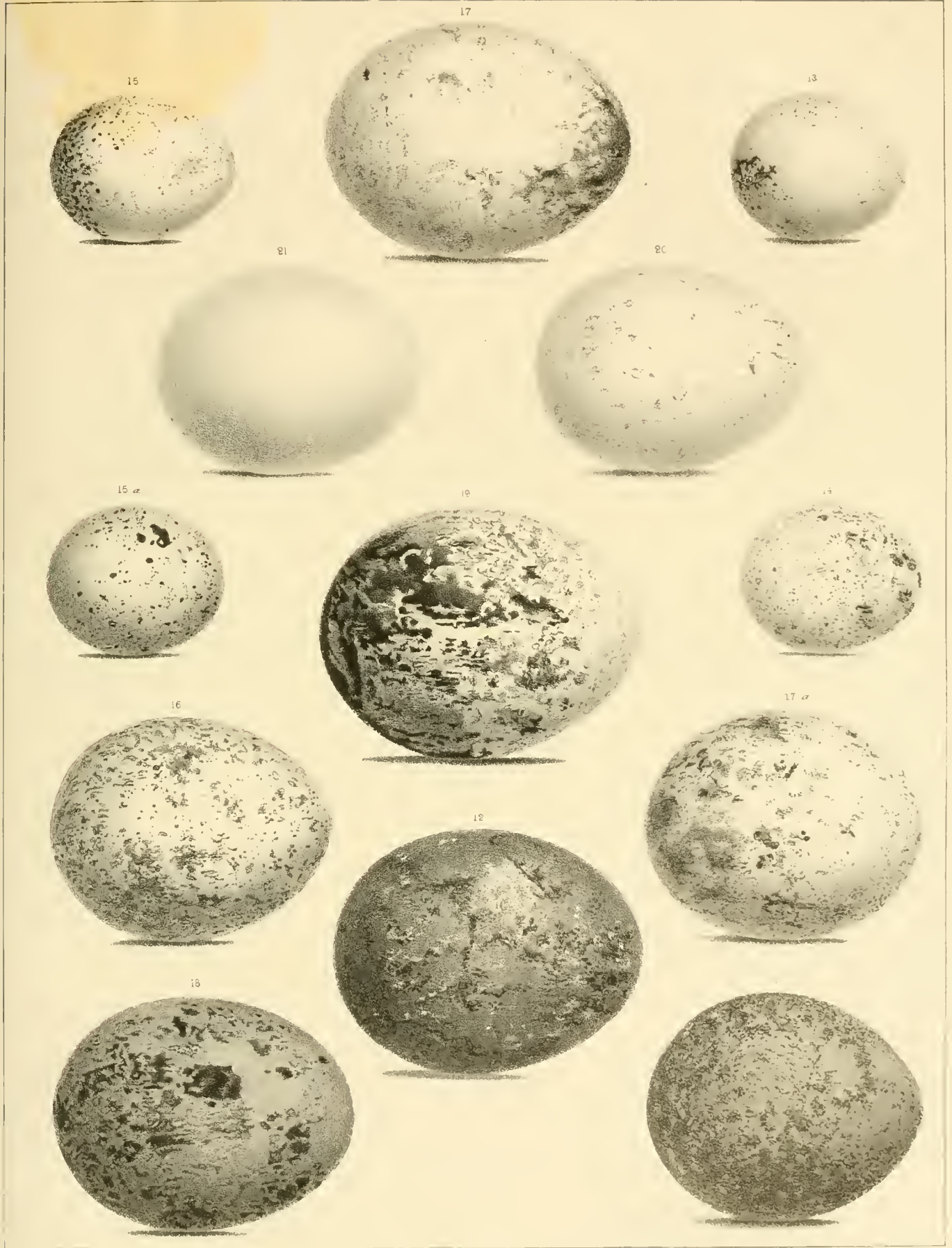
3, 4. CATHARTES ATRATUS.

5. ASTUR ATRICAPILLUS

6 BUTEO MONTANUS

7 BUTEO CALURUS

8, 9, 10 BUTEO PENNSYLVANICUS



Jth Koehler del

Bowen & Co. Ph. Sc.

11 FALCO ANATUM
12 HIPROFALCO SACER
13. 14. 15. 15 *a* TINNUNCULUS SPARVERIUS.
16. 17. 17 *a* BUTEO BOREALIS
18. 19 POLYBORUS [illegible]
20. 21 MORPHNUS UNICINCTUS

Otto Knirsch del

Bowen & Co Lith Phila

22. HYPOTRIORCHIS FEMORALIS.
23, 24. ACCIPITER FUSCUS.
25 BUTEO LINEATUS
26 ARCHIBUTEO FERRUGINEUS.
27 BUTEO INSIGNATUS.
28. ARCHIBUTEO SANCTI-JOHANNIS
29 ARCHIBUTEO LAGOPUS
30. BUTEO SWAINSONII
31, 32. CIRCUS HUDSONICUS
33, 34 PANDION CAROLINENSIS
35 HYPOTRIORCHIS COLUMBARIUS.

36 CIRCUS HUDSONICUS
37 HALIAETUS LEUCOCEPHALUS
38 STRIX PRATINCOLA
39 BUBO VIRGINIANUS
40 SCOPS ASIO
41 SCOPS MC CALLII
42 OTUS WILSONIANUS
43 BRACHYOTUS CASSINII
44 SYRNIUM NEBULOSUM
45 NYCTALE ACADICA
46 ATHENE HYPUGOEA
47 HIRUNDO BICOLOR
48 PROGNE PURPUREA
49 COTYLE RIPARIA
50 " SERRIPENNIS
51 ACANTHYLIS PELASGIUS
52 ALCEDO ALCYON
53 " AMERICANA

Otto Knirsch del

Bowen & Co Lith Phila

54 ACCIPITER FUSCUS
55. „ . COOPERI.
56 ANTROSTOMUS CAROLINENSIS
57 ANTROSTOMUS VOCIFERUS.
58 „ NUTTALLII
59. 60 61. CHORDEILES VIRGINIANUS
62. „ TEXENSIS
63. 64. 65. 66. 67 HIRUNDO RUFA.
68. 69. 70. 71 72 73. „ LUNIFRONS.
74. „ THALASSINA

Print in Col. by Siebert & Kogge Washington D.C.

Total eclipse of the Sun. 7th September 1858, as seen by Lieut. Gilliss, near Olmos, Peru.

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

AN ACCOUNT

OF THE

TOTAL ECLIPSE OF THE SUN

ON

SEPTEMBER 7, 1858, AS OBSERVED NEAR OLMOS, PERU.

BY

LIEUT. J. M. GILLISS.

[ACCEPTED FOR PUBLICATION, JANUARY, 1859.]

COMMISSION

TO WHICH THIS MEMOIR HAS BEEN REFERRED.

Prof. J. S. Hubbard,
J. H. Lane, Esq.

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PHILADELPHIA.

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AN ACCOUNT OF THE TOTAL ECLIPSE OF THE SUN,

ON SEPTEMBER 7, 1858, AS OBSERVED NEAR OLMOS, PERU.

THE JOURNEY TO OLMOS.

An announcement having been made that observers would leave England, and probably France also, for the purpose of observing, in Brazil, the total eclipse of the sun, which would take place on the 7th September, 1858, as no one was mentioned who contemplated visiting the rainless region on the west coast of South America, for that object, on the 8th June last I addressed a letter to Professor Joseph Henry, Secretary of the Smithsonian Institution, offering to undertake the journey, if no astronomer more competent to the task to be accomplished should volunteer his services.

Through the zeal for the advancement of science which has marked the administration of the affairs of this Institution under that eminent physicist, the proposition was promptly accepted, and arrangements for departure from the U. States were speedily made.

Prof. A. D. Bache, Superintendent of the U. S. Coast Survey, very liberally contributed the necessary instruments for accurate determination of the geographical position and time at the station which might be selected, and a tent for our shelter at night; Commander M. F. Maury, Superintendent of the U. S. Naval Observatory, furnished two excellent pocket chronometers; and Mr. Henry Fitz, of New York, who had made the object-glass for the equatorial of the U. S. Naval Astronomical Expedition, with great liberality specially completed and loaned a 4¼ inches achromatic telescope, mounted on an equatorial stand, suitable for all latitudes.

Accompanied by a young friend from New York—Mr. C. H. Raymond—I left that city on the 5th of August for Payta, in Peru; and traversing the isthmus of Panama on the 14th, we reached Payta on the morning of the 21st of the same month.

On landing at the latter place, most unfavorable accounts were given me of the condition of the atmosphere near the coast, about the hour of sunrise; and the contradictory opinions concerning that of the interior at the same period of the day—more especially at that season of the year—were very discouraging. All were agreed, however, that a land journey from Payta to a point on or near the Andes, which would be traversed by the central line of the moon's shadow, must be

attended by many privations and great exposure and fatigue. On the other hand, the commander of the steamer on which I had come to Payta, warned me of the risks of landing with instruments through the heavy surf at Lambayeque,[1] and of the possibility that he might be obliged to leave me on board of one of the trading vessels anchored in the roadstead, where many days might be passed before a safe opportunity would occur for disembarking. Weighing all the circumstances, I concluded to remain at Payta, and be governed by the information and experience which a brief residence there would enable me to obtain.

On the same day, through Capt. d'Aignan, of the steamer of war Mégère, I received a message from the admiral of the French fleet in the Pacific, most courteously offering to convey me in the Mégère to any point on the coast, or to facilitate, in any other manner in his power the observations which were the object of my journey. His interest for the advancement of astronomical science was also shown in 1850, when he detailed M. Kutczycki for observation of the total eclipse which took place on the 7th August of that year, and his considerate offer on this occasion was gratefully appreciated. As it was most desirable to increase the number of stations and observers, Capt. d'Aignan received instructions to remain at Payta, and carry out the arrangements which might subsequently appear to promise the best results.

During the following eight days there was only one when the sky was clear to the eastward at sunrise. Cirrus clouds formed before daylight, and continued to obscure nearly the whole heavens until between 9 and 10 o'clock A. M. About these hours the southerly wind usually commenced, and this, together with the increasing heat, apparently dissipated the clouds. Towards 3 or 4 o'clock P. M. they formed again and continued until dark, often assuming a cirro-cumulo or cumulo form. From that time, also, the strength of the wind gradually decreased, and there were variable airs from the sea throughout the night, which was usually clear and the stars brilliant. It is to be presumed that clear nights preponderate, for the populace have a distich—

"La luna de Payta,
Y el sol de Colan"
(The moon of Payta,
And the sun of Colan);[2]

and the inference is legitimate, that the two places are respectively favored by the brilliancy of the celestial bodies named.

The experience of eight days showing that the probabilities of a favorable morning near the coast were against us, on the 28th I resolved to leave instruments with Capt. d'Aignan and proceed to the interior, selecting there such station as from the information to be acquired, might seem to promise the best results. And at an

---

[1] Lambayeque is 22 Peruvian leagues from Olmos, and the road between them is through a cultivated valley offering resources the whole way. Dr. Moesta was prevented from landing there (by surf) until 5th September; and could only reach Motupe, a village 5 leagues south of Olmos, and where he had a cloudy morning on the 7th.

[2] The name of an Indian village also near the sea, but a few leagues north of Payta.

interview that day with this officer it was arranged that he should proceed with the Mégère to Punta de la Aguja, at the southern side of Sechura Bay, and some 60 miles south from Payta, where the central line of the shadow would first touch the continent. M. de la Pinelais, one of the officers of the Mégère, was selected by his commander to make the physical observations, and the zenith telescope and a chronometer lent by Professor Bache were furnished him, after having fully explained the mode of using the former during the eclipse.

Dispatching the Fitz telescope, with the essential smaller instruments, our tent, and provisions on the same afternoon, in company with Mr. Raymond I left Payta before daylight of the 29th, taking with me the barometers and pocket chronometers. We reached Piura, a town of some 10,000 inhabitants, and 45 miles distant from Payta, about 5 P. M. The country between the two places is a desert of sand, which is so drifted by the strong daily winds that the mule paths are obliterated almost as soon as made, and the traveller finds his way by the tall stakes that have been planted and the skeletons of animals that have died on the road from heat and thirst.

Letters of introduction to residents of Piura, most likely to afford reliable information, had been kindly furnished to me, and expectations had been formed that an officer of the Peruvian navy, thoroughly acquainted with the climate of the Andes, and himself an amateur astronomer, would most cheerfully accompany us. He was, unfortunately, absent, and the information derived from others, like that imparted at Payta, was of so contradictory a character as only to have the effect of discouraging.

Ascertaining from a recently published map that Olmos, a town within the outer Andes range, would certainly be included by the limits of the moon's shadow, and, possibly, be very near to its central line, preparations were made for a journey thither, and we departed from Piura before daylight on the morning of September 1st. Our train comprised myself, Mr. Raymond, two muleteers, one of whom was guide, and eight animals, two of which carried provisions for their subsistence.

In order that a supply of water might be obtained for the animals at the end of each day's journey, we took the direction of Vicuz, a cattle estate 50 miles E. N. E. from Piura, and lying on both banks of the river of the latter name. At that time the water of the river had ceased to flow 10 miles above the estate, though supplies were still obtained by digging shallow cavities in the dry bed. That for our own use—strongly impregnated with both nitre and lime—was carried by the muleteers in calabashes.

The second day's journey was more fatiguing than that from Payta to Piura. The country is all deep and loose sand on an undulating surface, and though there are occasional isolated trees, as the wind is cut off in the hollows, the heat there is most oppressive. We encamped after night, in a grove of majestic Algarrobos, near the dry bed of the Piura.

Before daylight of 2d September we were in the saddle again. The distance before reaching water was nearly 60 miles in a S. S. E. direction, the character of the country very similar to that between Piura and Vicuz, though with an increasing number of dwarf trees as we gradually approached the foot of the Andes. Before

nightfall we were travelling south, and quite near to the base of one of the outer ranges. Here we found, both then and on the journey back, that the direction of the wind was parallel with the mountains, and its force less than half what we experienced in crossing the plateau between Payta and Vicuz. Although it drives clouds of a fine and almost impalpable sand along with it, and their volume depends upon its velocity, at any diminution of the last the traveller instantly suffers from a great apparent increase of temperature. On this day our guide lost the track, and we were detained some hours whilst he was searching for it.

Our destination was Tortolitas—a name given to two or three scattered ranchos near a small spring of very brackish water. A headache, unquenchable thirst, and fever experienced during the last five hours of the journey thither, were attributed to the exposure and fatigues of the day, nor was I undeceived until two days afterward. On arriving, we learned that as there was scarcely water to supply the people and their limited number of goats and pigs, none could be afforded for our mules. But the hospitality of their humble shelter was readily granted, and scanty as was their supply and late as was the hour, the best of their food was freely prepared for us.

On the morning of the 3d the mules were suffering for want of water. We therefore started earlier than usual, intending to make a halt at Ñaupe, another collection of scattered ranchos, 5 leagues from Tortolitas, and near which there is a better supply of water. At seven miles from Ñaupe we crossed a low pass in the outer broken range of the Andes, and descended on the S. E. side to the level of the plain just left. The summit was reached about sunrise, and we once more had the pleasure to witness the solar rays unobstructed by clouds, at that hour. At the same time, however, all the lower elevations, as well as the plain to the westward, were obscured under a veil so impenetrable that there was not one illuminated point visible in that direction.

Owing to the distance of the spring from the rancho where we halted, and the slowness with which the water flowed, we were detained until 2 P. M., making it necessary to ride until quite a late hour. So long as the track could be distinguished, and there was no danger of going astray, as we escaped both heat and dust, this was the most pleasant period for travelling; but as we had twice been lost in broad daylight, and more than one had been known to perish of thirst on that desolate level, we necessarily moved with caution. This night was remarkably clear —surpassing the transparency of atmosphere witnessed in Chile so frequently— indeed, the planet Venus cast a well-defined shadow as late as 8 P. M. At 11 o'clock we camped on the sand for the night, having travelled about 25 miles over a country similar to that already mentioned.

Starting before sunrise on the morning of the 4th, we reached Olmos at 11 A. M. The last four or five miles of the journey is near the dry bed of a water-course, whose banks are covered with majestic trees of various descriptions. Here too there are a great many patches of cultivated ground. As the region is, in fact, within the Andean ranges, and the population reasonably expect one shower of rain during the year, they prepare the ground and put in the seed. If the rain fails, they dig in the dry bed of the water-course and obtain water enough for irrigating

their small fields once, or at most twice. This is sufficient for the growth and maturity of their crop.

Ascertaining that there was no house of public entertainment, and being unwilling to follow the custom of the country by asking hospitality at the residence whose appearance was most inviting, as the schoolhouse was then unused we succeeded in obtaining permission to occupy it, and proceeded there with the equipment, until I could make inquiries respecting the road across the Andes and the climate on the summit.

Curiosity had induced several of the citizens to follow us, and our mules were scarcely unloaded before others arrived, instigated by the same feeling, but all of them ready to impart any information or to give us any required aid.

By noon I was shaking with an ague, whose violence increased through more than two hours, and which did not cease until nearly sunset, when I was greatly exhausted. The fever continued nearly all night. This rendered the journey to an elevated point of the Andes impracticable, if not hazardous; and, after obtaining time sights for the chronometers on the morning of the 5th, as soon as I found myself strong enough, I decided to seek the best of the neighboring hills, from whence the observations might be made, without the risk of a crowd from the town, yet near enough to it for succor in case of continued illness. Such an one was found one mile S. E. from Olmos, and we encamped upon it on the afternoon of the same day.

Meantime, in accordance with experience gained of the disease in the U. States, remedies had been taken for it, and there was no return of the ague on the 6th of September. Instead of it, there was such excessive fever, accompanied by violent pain in the head and vertebræ during the entire day, that it was impossible to sit up until late at night. But to be prepared for a favorable change in case the following morning should prove clear, whilst lying upon the ground, I instructed my young friend as to each portion of the telescope until it was satisfactorily mounted. A little later, though weak from fasting three days, and the effects of the medicines, I was strong enough to make sextant observations for latitude on *α Lyræ*, *α Cygni*, and *α Gruis*, and to adjust the telescope approximately to the meridian and elevation of the pole by the same stars. I must acknowledge, however, that when I again laid down, it was with a hope that the morning would prove cloudy, for a return of the illness was apprehended, and an overcast sky would have been far more satisfactory to me than compulsory inactivity. Before daylight, however, I was up and quite able to work.

I hope these personal details will be pardoned. They have been thought necessary, because my expectation regarding one of the phenomena of total eclipses was not realized, and it does not become me to decide to what extent my physical condition may have had influence.

THE STATION.

Our camp was erected upon a small level spot, on the northern ridge of a spur from the Andes, the line of which from the main chain is a segment of a circle.

The best ascent to it was on the eastern side, both the northern and the western being too precipitous for loaded animals. Indeed, the ascent of the western slope is almost impracticable for even pedestrians. To the east, the Andes form a serrated but apparently unbroken chain, with lateral spurs at unequal distances extending to the westward. The greatest depression bore E. by N. from our camp, the crests there being estimated to form an angle of 8° with the horizon and 20 miles distant in a straight line, corresponding to an elevation of about 15,000 feet. From a mean of the barometrical observations made at various hours of three days, our elevation above the plain was 300 feet, and above the level of the sea 930 feet.

Between us and the spur next on the north, there is a narrow valley having a broad band of verdure on each side of the dry water-course, already mentioned. To the north the view extended over a nearly level plain as far as the mountain pass beyond Ñaupe. Northwest and west, there are lofty, isolated hills, mostly of bare and precipitous rock, and west of them again, perhaps ten miles distant, are the lower broken ranges of the coast mountains. To the south the view was interrupted at a short distance, partly by hills similar to the western ones and partly by the spur we were encamped upon.

From a mean of meridian and circum-meridian altitudes of *α Lyræ*, *α Cygni*, and *α Gruis*, made at camp on the nights of 5th and 6th September, with sextant and artificial horizon, its latitude was found to be S. 6° 0′ 2″. That of Olmos, from similar observations of the same stars on the night of the 8th September, S. 5° 59′ 20″. Applying to the latter the difference of latitude (42″), we have—accidentally—a result varying only 0″.1 from the former, whilst some of the individual determinations differ more than 40″. I adopt for the station

Latitute 6° 0′ 2″ south.

On the local map, previously referred to, and which purports to have been compiled from Humboldt, Fitzroy, and others, the longitude of Olmos west of Greenwich is 80° 22′ 20″. On the map of Arrowsmith (*London*, *May*, 1839), made up in part from Capt. Fitzroy's labors, and which accompanies his narrative, it is in 80° 4′ 30″. Neither Humboldt nor Fitzroy ever visited the interior of this portion of Peru, nor can I learn that its geographical position on the maps rests upon any better determinations than the estimations of native travellers between it and Lambayeque, not one of whom—most probably—possessed even a pocket compass. Unless the line of the Andes is placed on both maps very far out of the way, the longitude given by Arrowsmith is much the nearer to the truth. But, I shall proceed to show that this, as well as the whole coast of South America north of Valparaiso, is probably laid down by Capt. Fitzroy too far to the westward.

The longitude of Santiago de Chile, deduced from all the moon culminations and occultations observed by the U. S. Astronomical Expedition (vol. III. p. l), during the years 1849—'52, is W. $4^h\ 42^m\ 33^s.81$ (70° 38′ 27″.1), and the difference of longitude between the observatory there and that of Mr. Mouatt, at Valparaiso, was found by exchanging 100 telegraphic signals—(50 in each direction)—to be $3^m\ 56^s.51$ (59′ 7″.65). Consequently, the longitude of Valparaiso would be 70° 37′ 35″.

Capt. Fitzroy, R. N., places Fort San Antonio at Valparaiso in 71° 41′ 15″, and as there is no important difference of meridians between his station there and Mouatt's observatory, if the result from the 235 corresponding moon culminations and occultations observed at Santiago is to be depended upon,[1] Capt. Fitzroy's longitude of Valparaiso is 3′ 40″ too great. His longitude of other points on the west coast of America, being derived from chronometric differences, if his chronometers had accumulated an unknown error of 14ˢ.67[2] before arriving at Valparaiso, all his determinations of places north of that city will probably be affected to at least an equal amount.

Correcting the longitude of Olmos given on Arrowsmith's map for the probable error of 3′ 40″, and applying the distance of our station east of the town —42″ to the result, we have for a preliminary longitude 80° 0′ 8″ W.

Bringing forward to the morning of the eclipse the errors of the chronometers by the rates given me at leaving New York, the results are:—

Longitude by Arnold N°. 6220	79° 17′ 36″.6
" " Barraud N°. $\frac{2}{7\,3\,9}$	79° 27′ 20″.1
Mean	79° 22′ 28″.4

From Payta to the station, these instruments were carried, during the day, in inside pockets of my vest, and were necessarily jolted by the motion of the mule. At night they were placed in the travelling bag which constituted my pillow. There is no doubt that their rates were changed; for the mean daily rate of Arnold N°. 6220 was —7ˢ.85 between the morning observations of the 5th and those on the afternoon of the 8th, against a daily losing rate of 1ˢ.8 with which it left New York, and that of Barraud N°. $\frac{2}{7\,3\,9}$ was —6ˢ.57 daily against —3ˢ.5 daily.

Using the *preliminary* longitude, and assuming as correct the tabular places given in the American Ephemeris for 1858, Mr. F. G. Hesse, Assistant U. S. Astronomical Expedition, has computed the following longitude whilst these pages have been in preparation:—

West 79° 42′ 53″.4

THE ECLIPSE.

The telescope specially completed and most courteously lent for the occasion by Mr. Henry Fitz, of New York, is an achromatic, having an object-glass of 4¼ inches clear aperture with a focal length of 5 feet 4 inches. It is supported upon

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[1] 70 observations of moon culminations subsequently made at the Santiago observatory, and computed by Dr. Moesta, give for its longitude 4ʰ 42ᵐ 32ˢ.37. Still less!

[2] Capt. Fitzroy says of his chain of chronometric differences round the globe: "It ought to be clearly stated, however, that the sum of all the parts which form the chain amounts to more than 24 hours, therefore error must exist somewhere; but what has principally caused the error, or where it may be said to exist, I am unable to determine. The whole chain exceeds 24 hours by about thirty-three seconds of time."—*Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle*, Appendix to volume II. page 345. London, 1839.

a mahogany tripod with a cast-iron mounting, having equatorial motion and adjustable to every latitude. It was counterpoised in all positions. The eye-piece selected for use magnified 60 times, and the screen of glass was of a moderately dark green color. The latter was not fitted on the rim of the former, but was held in the hand so as to be removed at pleasure, and without the risk of disturbing the instrument whilst so doing.

In anticipation of the difficulty which would attend micrometrical measures of either kind during the very brief period the total eclipse would continue, a cross of wires, at right angles to each other, was inserted in a perforated card disk, and fitted to the eye-piece. Then, to facilitate the location of, and approximate to the elevation of such solar protuberances as might become visible, a diagram was prepared. Three concentric circles were drawn upon a page of the note book. The inner one—to represent the moon—was of 4 inches diameter—a black continuous line; the outer ones respectively one-eighth and one-quarter of an inch greater, but with broken lines. The inner circle was divided into equal segments of $22\frac{1}{2}°$ each, the vertical diameter on the page to correspond with the zenith and nadir of the station. The outer circles were to facilitate estimations in altitude of the protuberances, by comparison with the visible lunar diameter, all of which was in the field of the telescope.

The night of the 6th and until daylight of the morning of the 7th September was bright and faultless; but just before sunrise, a few banks of heavy cumuli formed over and near the distant mountains to the eastward, the part of the sky least obscured being in the direction of the sun. Some of the intermediate peaks became enveloped in fog banks at the same time, whilst thin cirri stretched to near the zenith. The wind was then from the westward and the atmosphere humid, under the influence of which, the lower strata of clouds increased in numbers and density, and the sun continued invisible until after the eclipse had made considerable progress. By $6^h\ 30^m$ all the fog banks to the north and west were drifting towards the valley of Olmos, and at 7^h there was no portion of the sky entirely unclouded. Whenever the sun became momentarily visible during that period, the cusps could not be satisfactorily seen because of the masses of vapor continuously rolling across its disk. At about $7^h\ 15^m$ there was a striking change; the whole mass of cumuli to the eastward was lifted towards the zenith, leaving that portion of the sky clear, and it was only by close examination that a delicate film of vapor could be detected between us and the sun. At this period, the general light did not greatly differ in intensity from that of the moon when nearly full, though its color resembled more that from burning spirit than that of the sun. Both intensity and color changed under the feeble and gloomy illumination with perceptible rapidity, and for a minute before the first internal contact of the limbs, the hills near us appeared of a *black* hue.

At from twelve to fifteen seconds before the beginning of totality the entire lune—then perhaps 35° in extent—broke up into masses of unequal length, showing detached portions wholly separated from the rest by dark lines. The occurrence was so sudden as to startle me, and although within the ten following seconds, the remaining visible fragments had become brilliant globules of nearly equal size, they

differed from Baily's beads as seen by me during the annular eclipse of September, 1838, by the darker spaces which separated them from one another.

When the total obscuration took place at $7^h\ 30^m\ 42^s.5$, four masses of luminous clouds became immediately visible at as many positions of the lunar circumference. Perhaps that to the left on the drawing was the first one seen, because my attention was directed there in watching the disappearance of Baily's beads, but I cannot say that they were not all simultaneously perceptible. The screen of glass was hurriedly removed, and in the brief instant of doing so I found, to my surprise, that all the phenomena were distinctly visible to the unassisted eye. Every effort has been made by the artist to represent in the accompanying lithograph—drawn from the sketch and notes—the scene then before me, and which still remains strongly impressed upon my memory.

Of the four cloud-masses which had become visible, that on the upper border was much the most extended and serrated. It was more than 30° in extent, with an altitude, in the highest part, of about 30″. All of them were of as nearly the form, and at the relative positions given in the plate which the most careful estimations enabled me to assign to them, and sketch roughly in the note-book, whilst they were still in sight. Neither of them exceeded 1′ or 1′ 10″ in height. I could not discern any rose or pink color on either of them, but they all resembled irregular masses of illuminated clouds of leaden hue fringed with bright light, more especially at the edges farthest from the sun. Surprised at the absence of red—a color I fully expected to witness—and for the moment supposing my physical condition might have some influence, Mr. Raymond was requested to note the colors carefully.

A corona light flashed out at the instant of totality. It extended farthest from the sun, in lines drawn from the centre through the solar clouds, but was nowhere traceable more than 15′ or 16′ beyond the lunar disk. There were no radial streamers, or bundles of rays, but only a uniformly diminishing, and slightly orange-tinted light, whose brightness and extent were apparently influenced by the mist-film, as the color of the clouds also may have been. Beyond the corona light, the color of the sky was of a grayish-black.

It was a far more imposing sight without than with the telescope, and long as has been my experience in the observation of celestial phenomena, and calm and unimpassioned, at such times, as my temperament has become, the sublime majesty of the scene thrilled me with excitement and humble reverence. Nor was it less effective upon others. Two citizens of Olmos stood within a few feet of me, watching in silence, and with anxious countenances, the rapid and fearful decrease of light. They were wholly ignorant that any sudden effect would follow the total obscuration of the sun. At that instant, one exclaimed, in terror—"*La Gloria!*" and both, I believe, fell to their knees, filled with awe. They appreciated the resemblance of the corona to the halos with which the old masters have encircled their ideals of the heads of our Saviour and the Madonna, and devoutly regarded this as a manifestation of the Divine presence.

Every second of the time during which the total obscuration continued—*only sixty and a half*—was fully occupied in storing my memory with facts, and in tracing outlines of the solar clouds and corona. They did not permit me to turn

away for the observation of collateral phenomena, before it was necessary to watch for the sun's reappearance. This took place at $7^h\ 31^m\ 43^s$. The emersion was sudden. But, though the limb was then sharp, and without the least appearance of dislocation, during the next two or three seconds, there were faint vertical striæ over the lune which gave to it a slight oscillating motion. Assuredly neither the illuminated clouds nor the corona disappeared, at the actual instant of the return of light, but there was a brief period afterward, when their images were still upon my retina.

Though Mr. Raymond found a candle necessary to enable him to read satisfactorily the seconds-dial of the chronometer, and vernier-scale of the barometer, the darkness during totality could not have been very great, for my sketches were completed without the aid of artificial light. For some minutes previous, all work in the valley below us had ceased, and even the strains of martial music, which the Governor of Olmos employed to cheer laborers digging for water, two or three miles from the town, were no longer audible. Superstition is still dominant here, and we could hear the solemn toll of the church bell, whose sounds were intended to drive evil spirits from its vicinity. Neither at Olmos nor Piura, did any *enceinte* woman leave her room during the eclipse, whilst some from curiosity, but more through fear, were in the streets, yet not daring to look upon the sun, lest malady befall them. The sombre greenish light gave them the appearance of corpses, and they apprehended that a plague might be visited upon them. Afterwards, the muleteers told us that their animals stopped eating, and huddled together in evident alarm.

Very little actual change of temperature was to be expected. The coldest hour of the day had just passed, and as the sun rose above the Andes, its rays had greater power with each passing minute. But the thermometrical record shows that the rapid interposition of the moon absolutely arrested the normal increase of heat, and as late as 8 A. M., a half hour after total obscuration, the thermometer showed only 58°, whilst the mean temperature experienced by us, at that hour of the day was 72°! The light air from the westward, already mentioned, continued through the whole eclipse, and there were constant changes in the clouded portions of the sky during the same period. From shortly after noon, until the tent was closed after midnight, clouds obscured the whole sky.

Descending to Olmos early on the 8th, we left it on the afternoon of the 9th, and reached Payta, without mishap, on the afternoon of Sept. 14th.

The observations of time were as follows:—

Beginning of eclipse			Not seen.	
First internal contact of limbs	7^h	30^m	$42^s.5$.	Good.
Second " " "	7	31	43.0	Good.
End of eclipse	8	47	35.5.	Doubtful.
Duration of total eclipse		1	0.5.	

The chronometer was in charge of Mr. Raymond, and the records given by me are in *mean time* of the station. Observations of the altitude of the sun's limb, to determine the error of the chronometer on local time, were made before the end of the eclipse. Its rate in the interval was inappreciable.

OBSERVATIONS BY MR. C. H. RAYMOND.

Just before sunrise, the horizon was entirely obscured by clouds, but as the sun appeared above the eastern mountains, the sky became clear in that direction, and even there only in spots. As totality approached, however, there was only a thin fleece of clouds just before the sun, and this did not interfere with the vision.

Four solar protuberances were plainly visible to the naked eye, but they appeared to be of very nearly the same color as the corona, making it look more intensely bright. There was no pink or red color exhibited. They were distributed at pretty nearly equal distances round the moon, one being near each of the N. E., S. W., S. E., N. W. points.

As I was occupied with the meteorological instruments, I was unable to notice all the phenomena which took place. I did observe, however, that as the darkness came on, the birds ceased singing, and some laborers, digging a well near by, stopped working. All nature assumed a ghastly appearance, resembling a moonlight night.

So dark was it during the totality, that in order to distinguish the figures on the dial of a chronometer, I was obliged to hold it close to the lantern. While it was darkest, I looked at the sky to see if there were any stars visible, but there were so many clouds, that those which might have been seen were covered by the cumuli.

OBSERVATIONS OF THE FRENCH OFFICERS.

TRANSLATION OF A LETTER FROM CAPTAIN H. VIALETES D'AIGNAN,

Commanding the War Steamer Mégère.

PAYTA, *September* 10, 1858.

SIR: I fulfil a duty in thanking you for the instruments which you had the kindness to lend us. At the same time I beg to make known to you the result of our observations.

The observers were on shore in longitude 81° 3′ 20″ west from Greenwich, as taken from the chart of Capt. Fitzroy, and in latitude 5° 50″ south. The ship was one and a half miles N. 39° E. from the spot occupied by the observers.

Clouds prevented us from observing the first contact. The others took place at the following instants:—

	Observed on Board.	Observed on Shore.
First internal contact	$7^{h.}\ 24^{m.}\ 8^{s.}$	$7^{h.}\ 24^{m.}\ 8^{s.}$
Second internal contact	7 25 7	7 25 7
External contact (end)	8 39 38	8 40 15

The instants given are in *mean times* of the place of observation. We are not able to explain the difference which appears in the observations of the last contact.

If it be desired to refer the times of observation to the meridian of Payta, as we determined it on the morning following the eclipse, it is necessary to subtract $32^{s}.7$.

The barometer rose one millimetre:—

Mercurial Barometer.	Aneroid Barometer.
$0^m.761.5$	$0^m.751.5$
$0^m.762.5$	$0^m.752.5$

Most generally the aneroid coincides with the other barometer; the difference between the two instruments was constant on this day.

The temperatures observed were as follows:—

$6^h\ 0^m$	20°.0	Centigrade.
7 0	17.0	
7 15	16.5	Total eclipse.
7 30	17.0	
7 45	17.5	
8 0	18.5	
8 15	19.5	
8 30	20.3	
8 45	21.0	

Although the sky was somewhat cloudy, we perceived several stars during the total eclipse. The obscurity was very sensible, and it seemed to pass off more rapidly than it came on.

I remit herewith a note and a design from M. Pinelais, who observed the eclipse with the telescope you had the goodness to lend us. M. Laultré, who observed the contacts on shore, very distinctly saw the whitish corona that surrounded the moon during the total eclipse.

In repeating my thanks to you, permit me to ask that you leave for us, in Valparaiso, a copy of your own observations.

Accept, sir, the assurance of my most distinguished consideration.

VIALETES D'AIGNAN.

M. Gilliss, *Lieut. U. S. N.*

TRANSLATION OF NOTE FROM M. PINELAIS, FRENCH NAVY.

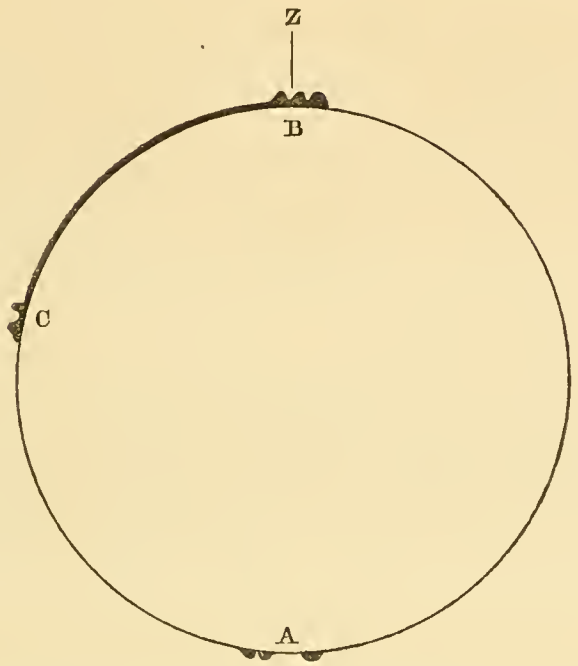
The spots observed appeared of a fine bright-rose color. Their maximum height may be valued at most 1′. The first to appear were those at A; then those at B, and finally, about the first third of the period of the eclipse, those which extend from B to C. The height of these last was less than that of the protuberances of A and B, except at the point C, where it was very nearly the same.

A little while before the commencement of the total eclipse, I saw, towards the centre of the moon, a spot of yellowish light of feeble intensity, but I was not able to follow it during totality.

The small extent of the field of the telescope prevented me from observing the luminous corona, which should have surrounded the moon during the total eclipse.

The position of the spot chosen for observation is long. 81° 3′ 20″ west from Greenwich (Fitzroy), latitude 5° 50′ south.

The instrument employed was a (zenith) telescope. The image given (on following page) is reduced.



[M. Pinelais translated all the important portions of the pamphlet containing "Suggestions to Observers," &c., by R. C. Carrington, Esq., and made copies of its diagrams prior to my departure for the interior.

The zenith telescope used by him has an object glass with an aperture of 3¼ inches, and a focal length of 43¼ inches. J. M. G.]

ACKNOWLEDGMENTS.

Through the courtesy of his Excellency, J. Y. de Osma, Minister Resident from Peru, official letters were received for the Prefect of the Province of Piurá, the Captain of the Port at Payta, and others, stating the objects of and asking for the expedition such facilities and aid as they could afford to it. The gentleman holding the latter office instantly directed that the cases containing our effects should be passed through the custom house unopened, and offered his services in any other way in which he could be useful. And on leaving Piura, the Prefect had the goodness to furnish me with a letter instructing the Governor of Olmos to see that all our wants were properly supplied. Without such support by the political authority—who has military as well as civil power—a traveller vainly contends against excessive demands made of him by the more than semi-Indian population of the interior. The Governor was both extremely attentive and kind.

Especial acknowledgments are due to the British Steam Navigation Company. The directors not only granted free transport with great cordiality, but also instructed their agents to facilitate the objects of the expedition by every means in their power. And so faithfully were these instructions carried out that I cannot too earnestly express my appreciation of the considerate kindness shown me by Messrs. Petrie, Hall and Bidwell, the manager and agents of the line at Callao,

Valparaiso and Panama; or of Capts. Wylde and Bloomfield whilst making the voyages on board their ships.

Nor were the companies of our own country less liberal. The U. S. Mail Steamship Company, the Pacific Mail Steamship Company, and the Panama Railroad Company each most cheerfully granted the use of their ships and cars, proffering every other assistance to the enterprise which it would be possible for their officers to afford. I had the good fortune to make the voyages to and from Aspinwall in that rapid steamer, the Moses Taylor, and it is proper that I should offer my tribute of commendation to the courteous attentions shown their passengers on these occasions by Capts. McGowan and Gray.

Notwithstanding the most strenuous efforts of Capt. Bloomfield, after leaving Payta for the north, we failed to reach Panama before the departure of the American steamer which left for New York on the 20th of November, and during two weeks' detention on the isthmus we were guests of the Pacific Mail Steamship Company. We were most hospitably entertained by the acting agent, D. M. Corwin, Esq., to whom we owe a double debt. He not only provided for every possible comfort whilst we were in health, but carefully tended us when prostrated by the fever of the isthmus. I say *we*, for my young friend—Mr. Raymond—had fairly earned a right to participate in courtesies offered to me, and was a fellow guest.

I abstain from naming my accomplished host at Payta from motives of delicacy.

METEOROLOGICAL OBSERVATIONS.

The instruments with which the following meteorological observations were made, were constructed for the Smithsonian Institution by Mr. James Green, of New York. The barometer, a syphon (Bunten's form), reads to $^{in}.002$, and was hung within the tent. All the thermometers are divided to 1° upon scales of ivory. The air and wet bulb thermometers were placed a few feet above the ground, and in the shadow of the tent. The black bulb was suspended beneath the telescope, its bulb within an inch of the ground.

Meteorological Observations at Camp during the Eclipse.

Hour.	Barometer.	Att'd ther.	Air.	Wet bulb.	Black bulb.	Remarks.
	in.	°	°	°	°	
6h. 20m.	29.128	57.0	56.4	56.2	58.0	The sun was obscured.
30		57.5	56.3	56.2	59.1	do. do.
40		57.2	57.2	57.1	66.9	
50	.142	58.8	57.8	57.2	66.0	
7 0		59.3	57.7	56.9	67.2	
10		59.4	57.6	57.1	66.3	
20	.162	58.6	57.7	56.9	62.2	
30		58.6	57.6	56.8	59.1	
40		58.4	57.5	56.9	60.5	
50	.168	58.6	57.6	57.0	64.3	
8 0		58.9	57.9	57.1	67.9	
14		60.0	58.7	57.4	69.8	
20	.176	60.5	59.3	57.8	74.8	
30		61.6	59.9	58.0	79.0	
40	29.184	62.6	61.1	58.6	84.1	

Meteorological Observations at Payta.

Day and hour. 1858.	Barometer.	THERMOMETERS.			WIND.		Weather.	Remarks.
		Att'd.	Air.	Wet.	Direction.	Force.		
	in.	°	°	°				
Aug. 22, 3 P. M.	29.966	72.5	71.9	64.9	South	4	0	
6 "	30.104	70.5	68.1	62.8	S. by E.	3	0	
9 "	.084	70.3	67.0	62.0	"	4	K. S. 5	
" 23, 9 A. M.	.128	68.0	67.0	62.3	"	1	K. 10	
Noon	.078	70.5	70.8	64.0	"	2	K. 4	
3 P. M.	30.018	72.1	71.6	64.3	S. S. E.	1	0	
6 "	29.918	70.4	67.4	62.4	S. by E.	3	0	
9 "	30.044	70.0	66.8	61.5	"	1	C. 7	
" 24, 9 A. M.	30.046	67.6	67.7	63.2	S. S. E.	1	K. S. 10	
Noon	30.014	71.5	74.1	65.5	S. by E.	1	0	Haze about high land.
3 P. M.	29.976	72.7	73.0	64.5	"	3	C. 1	do. do.
6 "	29.925	70.0	67.5	62.6	"	2	0	
9 "	30.038	69.6	67.0	62.1	"	1	C. K. 9	Observations a little late.
" 25, 9 A. M.	.096	67.9	66.5	62.0	N.W.byW.	2	0	
Noon	.078	71.5	73.2	65.5	S. W.	3	0	
3 P. M.	.054	71.3	71.2	64.0	"	2	C. S. 10	
6 "	.092	69.5	67.3	63.0	S. by W.	1	K. S. 10	Observations late.
9 "	.114	71.0	67.0	62.2	"	1	K. S. 10	do.
" 26, 9 A. M.	.186	68.7	68.8	63.0	S. E.	1	K. S. 9	
Noon	.166	72.5	75.8	66.0	S. by E.	1	C. 1	
3 P. M.	.064	73.1	73.4	63.9	S. S. W.	4	0	
6 "	.088	70.0	68.0	62.5	"	2	K. 3	
9 "	.112	70.5	67.0	62.0	S. W.	2	C. 1	
" 27, 9 A. M.	.128	68.5	68.0	62.7	S. E.	1	C. S. 10	
Noon	.074	72.5	75.0	66.1	"	3	C. 5	
3 P. M.	.006	73.0	74.2	65.1	S. S. E.	2	C. 1	
6 "	.020	71.9	69.2	63.1	S. by E.	1	C. 1	Haze over sea horizon.
9 "	.092	71.3	67.0	62 7	E. S. E.	1	C. K. 7	Observations late.
" 28, 9 A. M.	.118	68.9	68.2	62.9	"	1	K. S. 10	
Noon	30.084	70.5	74.3	65.3	East	1	0	

The preceding observations, with the same instruments, were made at Payta before proceeding to the interior. The instruments were suspended in a balcony having a northern exposure, and 27 feet above the sea level. In the column "*Force of Wind*," 0 signifies "Calm;" 10 a "Gale." In the column "*Weather*," 0 signifies "Clear;" 10 "Entirely Clouded;" "K"—Cumuli—"C"—"Cirrus," &c.

After the noon observations of 28th, the thermometers were packed.

COMPUTATION OF THE TOTAL SOLAR ECLIPSE OBSERVED NEAR OLMOS, PERU, SEPTEMBER 7, 1858.

BY F. G. HESSE, ASST. U. S. N. AST. EXP'N.

The general theory adopted in the following computations is that of Bessel, as developed in the second volume of his *Astronomical Researches.*

The following quantities have been interpolated from the computed places in the American Ephemeris for the Greenwich meridian:—

α = the moon's right ascension.
δ = the moon's declination.
π = the moon's equ. hor. parallax.
α' = the sun's right ascension.
δ' = the sun's declination.
π' = the sun's mean equ. hor. parallax = 8″.5776. (Encke.)

Greenwich m. t. September	α			δ			α'			δ'		
	°	′	″	°	′	″	°	′	″	°	′	″
6th, 23h.	163	56	27.30	+6	26	18.8	165	43	19.80	+6	6	32.85
7th, 0	164	27	40.05	6	9	57.9	165	45	35.10	6	5	36.60
1	164	58	49.35	5	53	36.0	165	47	50.40	6	4	40.32
2	165	29	55.35	5	37	13.2	165	50	5.55	6	3	44.03

	π		*log* Radius Vector. *log* Δ'
	′	″	
23h.	58	47.15	.0030942
0	58	45.71	896
1	58	44.25	850
2	58	42.78	804

If a and b represent the right ascension and declination of the sun's centre, as seen from that of the moon, and g the distance of sun and moon's centres expressed in parts of the equatorial radius of the earth, we have:—

$$a = \alpha' - \frac{\sin \pi'}{\Delta' \sin \pi} \frac{\cos \delta}{\cos \delta'} (\alpha - \alpha').$$

$$d = \delta' - \frac{\sin \pi'}{\Delta' \sin \pi} (\delta - \delta').$$

$$g = 1 - \frac{\sin \pi'}{\Delta' \sin \pi}.$$

and we obtain the following values:—

	a			d			*log* g
	°	′	″	°	′	″	
23h.	165	43	35.26	+6	6	29.99	9.9989500
0	165	45	46.38	6	5	35.97	— 496
1	165	47	57.50	6	4	41.93	— 91
2	165	50	8.48	6	3	47.88	— 86

If we refer the moon's centre to a rectangular system of co-ordinates, whose origin is at the centre of the earth, the right ascension and declination of the axis z being equal to a and d, and the axis x being contained in the plane of the equator, and its right ascension equal to $90 + \alpha$, we have:—

$$x = \frac{\cos \delta \sin (\alpha - a)}{\sin \pi}$$

$$y = \frac{\sin (\delta - d) \cos \tfrac{1}{2} (\alpha - a)^2 + \cos (\delta + d) \sin \tfrac{1}{2} (\alpha' - a)^2}{\sin \pi}$$

$$z = \frac{\cos (\delta - d) \cos \tfrac{1}{2} (\alpha - a)^2 - \cos (\delta + d) \sin \tfrac{1}{2} (\alpha - a)^2}{\sin \pi}$$

which equations furnish the following computed values for x, y, and z.

	x	y	$\log z$
$23^{h.}$	—1.8107312	+0.3400625	1.7668066
0	—1.3214486	+0.0758885	1.7670886
1	—0.8321237	—0.1883356	1.7673333
2	—0.3427265	—0.4525875	1.7675401

If f = the angle which the axis of the cone forms with its side, and
c = the perpendicular distance of the vertex of the cone from the plane x, y,
we shall have

$$\sin f = \frac{1}{\Delta' g}(\sin h - k \sin \pi') \text{ (for internal contact)}$$

$$c = z - \frac{k}{\sin f} \text{ (for internal contact)}$$

$$c \tan g f = l$$

according to Burckhardt's tables of the moon, the radius of the moon, or $k = 0.2725$, and the mean radius of the sun, or $h = 15'\ 59''.788$ (Bessel). Therefore:—

$\log(\sin h - k \sin \pi') = 7.6666903$ (for internal contact), and

	$\log \tan g f$	l
$23^{h.}$	7.6646527	.0024447
0	7.6646572	.0022662
1	7.6646618	.0021107
2	7.6646663	.0019787

Assumed longitude of place of observation $= 80° = 5^h\ 20^m$.

	1st internal contact.	2d internal contact.
T = assumed corresponding Greenwich m. t. of observation	$0^{h.}\ 51^{m.}$	
x_0 = corresponding values	—0.9055260	
y_0 = " "	—0.1487045	
x_1 = hourly variation of x	+0.4893457	
y_1 = " " y	—0.2642366	
Θ = sidereal time at instant of observation	89° 59′ 10″.00	99° 14′ 19″.95
a = corresponding values	165° 47′ 37″.83	
d = " "	6 4 50.04	
ϕ' = geocentric latitude of place of observation	5 57 37	
$\log \rho$ = $\log$ earth radius	9.9999843	

The co-ordinates of place of observation are:—

$$\xi = \rho \cos \phi' \sin(\Theta - a)$$
$$\eta = \rho \{\cos d \sin \phi' - \sin d \cos \phi' \cos(\Theta - a)\}$$
$$\zeta = \rho \{\sin d \sin \phi' + \cos d \cos \phi' \cos(\Theta - a)\}$$

and the computed values:—

	First internal contact.	Second internal contact.
ξ =	—.914188	—.912450
η	—.144740	—.145167
ζ	+.378473	+.382480

	First.	Second.
Assuming $m \sin M = x_0 - \xi$ =	+.008662	+.006924
$m \cos M = y_0 - \eta$ =	—.003964	—.003537
$n \sin N = x_1$	+.4893457	
$n \cos N = y_1$	—.2642366	

and $\{l - \zeta \tan g f\} \sin \psi = m \sin(M - N)$,

we find

	For first internal contact.	Second internal contact.
	° ′ ″	° ′ ″
$M =$	114 35 25.08	117 3 33.83
$N =$	118 22 5.28	118 22 5.28
$log\ n =$	9.7451761	9.7451761
$log\ m =$	7.9789079	7.8907060
$\psi =$	350° 41 36.1	182 36 17.51

If $T + T'$ represents the required time of the first meridian, at which a phase of the eclipse was observed, d the east longitude, and t the local mean time of observation

$$T' = -s \frac{m \sin (M - N + \psi)}{n \quad \sin \psi} \qquad \begin{matrix} \text{First C.} \\ -86.33 \end{matrix} \qquad \begin{matrix} \text{Second C.} \\ -25.05 \end{matrix}$$

$$d = t - T - T' + h\,\varepsilon + h\,\zeta\ tang\ \psi$$

$$h = \frac{s}{2.06265\ n\ sin\ \pi} = 1.8369$$

$$h\ tang\ \psi = \begin{cases} -.30100 \text{ for first int. contact,} \\ +.08357 \text{ for second int. contact,} \end{cases}$$

$$\varepsilon = sin\ N\ cos\ \delta\ \Delta(\alpha - a) + cos\ N\ \Delta(\delta - d),$$

$$\zeta = -cos\ N\ cos\ \delta\ \Delta(\alpha - a) + sin\ N\ \Delta(\delta - d),$$

$$d = \begin{cases} 18^h\ 41^m\ 8.83 + 1.8369\ \varepsilon - 0.30100\ \zeta, \\ 18\ 41\ 8.05 + 1.8369\ \varepsilon + 0.08357\ \zeta. \end{cases}$$

The observations of the French officers furnish us with the following values:—

Approximate longitude $= 80°\ 59'\ 40''$

Geocentric latitude $= -5\ 47\ 40$

$$t = \begin{cases} 19^h\ 24^m\ 8^s \text{ first internal contact,} \\ 19\ 25\ 7 \text{ second internal contact.} \end{cases}$$

Computing as before, we obtain the following values for the east longitude of their station from the Greenwich meridian:—

$$d' = \begin{cases} 18^h\ 35^m\ 53^s.89 + 1.837\ \varepsilon - 0.483\ \zeta, \\ 18\ 35\ 54.76 + 1.837\ \varepsilon + 0.284\ \zeta. \end{cases}$$

Therefore,

$$d - d' = \begin{cases} 5^m\ 14.94 + .182\ \zeta, \\ 5\ 13.29 - .200\ \zeta. \end{cases}$$

As no observations were made at a station whose longitude was known, the values of ζ and ε cannot be determined.

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

DISCUSSION

OF THE

MAGNETIC AND METEOROLOGICAL OBSERVATIONS

MADE AT THE GIRARD COLLEGE OBSERVATORY, PHILADELPHIA,
IN 1840, 1841, 1842, 1843, 1844, AND 1845.

PART I.

INVESTIGATION OF THE ELEVEN YEAR PERIOD IN THE AMPLITUDE OF THE SOLAR-DIURNAL VARIATION AND OF THE DISTURBANCES OF THE MAGNETIC DECLINATION.

BY

A. D. BACHE, LL.D.

[ACCEPTED FOR PUBLICATION, JUNE, 1859.]

COMMISSION

TO WHICH THIS MEMOIR HAS BEEN REFERRED.

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COLLINS, PRINTER,
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INTRODUCTION.

In co-operation with the scheme adopted at the British colonial observatories, a series of magnetic and meteorological observations were made at the Girard College magnetic observatory, in Philadelphia, with instruments purchased under the direction of the trustees of the college, the observations being made under the patronage of the American Philosophical Society, and finally completed for the use of the topographical bureau of the War Department.[1] These observations were made under my immediate direction, and were afterwards left under my general superintendence. The series commenced in May, 1840, and, with short interruptions, terminated in June, 1845, thus furnishing a five years' series of magnetic observations, taken bi-hourly up to October, 1843, and after that date hourly. The readings of each magnetic element were united into mean values, arranged according to hours of the day and days of the month and annual values, and presented graphically, under my direction, by Joseph S. Ruth, Esq., who had taken part in the observations, and who was at that time employed in the Coast Survey. As, owing to other laborious duties, the record could not then be submitted to a complete reduction and discussion, I have resumed the subject, with the aid of Charles A. Schott, Esq., assistant in the Coast Survey, by whom, under my immediate direction, the discussions contained in this paper have been made and prepared for publication. It is proper to state that this work has been performed out of office hours by Mr. Schott, as my assistant in this special matter, and at my own expense.

Although the magnetic observatories furnished by their judicious geographical location, a basis for the generalization of their results, it is, nevertheless, desirable to combine other results with them as confirmations, or as corrections. In the investigation of the disturbance law at Point Barrow, as compared with the same at Toronto, a very remarkable mutual relation was developed, and further examination may bring to light other dependencies of a mutual character.

According to the latest determination, the position of the Girard College observatory is in latitude 39° 58′ 23″ (north), and in longitude 75° 10′ 05″ = $5^h\ 00^m\ 40^s.3$

[1] See "Observations at the magnetic and meteorological observatory at the Girard College, Philadelphia, made under the direction of A. D. Bache, LL. D., and with funds supplied by the members of the American Philosophical Society and by the Topographical Bureau of the United States, 1840 to 1845. Printed by order of the Senate of the United States, and under the direction of the Topographical Bureau, second session of the twenty-ninth Congress. Washington, D. C., 1847." Three volumes record and one volume plates.

west of Greenwich.[1] From Philadelphia, Toronto bears 38° 45′ west of north (true), and is distant 4° 50′ in arc, or about 334 statute miles.

It is proposed in the present paper to investigate the law of the eleven year period, or as it is more frequently called, the decennial period, there being yet an uncertainty as to its precise length. It is supposed to have some direct or indirect connection with the solar spot period, which, according to late investigations by Prof. R. Wolf,[2] is said to exhibit corresponding disturbances.

The discussion is a contribution towards the determination of the epoch of the occurrence of a minimum (as to number and magnitude) in certain phases of the magnetic variations and disturbances, corresponding to a minimum in the solar spot period. The method of reduction is substantially the same as that adopted by General Sabine, and explained in his discussion of the Toronto and Hobarton[3] observations.

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[1] This longitude depends on that of Cambridge observatory, for which $4^h\ 44^m\ 30^s.25$ has been adopted.

[2] Astronomische Nachrichten, No. 1091 (May, 1857).

[3] See three papers by General Sabine, on periodical laws discoverable in the mean effects of the larger magnetic disturbances. Philosophical Transactions of the Royal Society, 1851, 1852, and 1856.

INVESTIGATION OF THE ELEVEN YEAR PERIOD

IN THE

CHANGE OF THE AMPLITUDE OF THE SOLAR-DIURNAL VARIATION OF THE MAGNETIC DECLINATION, COMPRISING THE REGULAR AS WELL AS THE DISTURBED DIURNAL VARIATION.

While the magnitude of the deflection is the only criterion for the recognition of a disturbance, the adoption of any limit of deviation from the normal value for the same hour, month, and year, must necessarily remain in some measure arbitrary, or, in other words, there must always remain, after the separation of the disturbances, a certain small amount of their effect in the remaining regular diurnal progression. General Sabine has shown that the results are not sensibly affected by a small variation in the line of separation of the disturbed from the undisturbed readings.[1]

To effect the separation, I made use of Peirce's criterion,[2] for the rejection of doubtful observations, applying it, however, to observations following a law different from the regular one.[3] From an examination of 465 hourly observations, distributed over different hours of the day and different months of the year, the following was the limit of separation:—

9^{d}.3	from six months	in	1840
8.1	"	"	1843
6.0	"	"	1845

The mean or 7.8 divisions, equal to 3′.6 of arc, has been adopted provisionally. Accordingly, all numbers in the printed record of observations, differing 7.8 scale divisions (or 10.3 divisions for June, and, up to July 18, 1840), from the mean monthly value at each hour of observation, were marked in pencil. It was found that the ratio of the disturbed observations to the total number was 1 : 9.6, or for

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[1] In the first discussion of the Toronto observations for the years 1843, 1844, 1845, the limit of 3′.6 was adopted, corresponding to one disturbance in every 13.6 observations; in the second discussion 5′.0 was substituted as preferable. Phil. Trans., 1856, art. xv.

[2] Gould's Astronomical Journal, vol. iv., No. 83, 1855.

[3] A similar application was made in the discussion of Dr. E. K. Kane's magnetic observations at Van Rensselaer Harbor, North Greenland, by Mr. Schott. Smithsonian Contributions to Knowledge, vol. x., 1858.

the years 1843, 1844, 1845, 1 : 13.3 nearly (the years 1843 and 1845 being incomplete, and omissions only approximately allowed for). For comparison with the Toronto observations we have the ratio 1 : 9.4 for the series 1841 to 1848, inclusive,[1] and 1 : 13.6 for the series 1843, 1844, 1845,[2] both for the limit 3′.6, which was afterwards raised to 5′.0.[3] It was thought desirable in comparing these results, and especially as the Girard College observations do not extend either way to years of maximum of disturbance, which would otherwise require the enlargement of the limit, to preserve the limit as pointed out by the criterion; hence a deviation from the normal of 8.0 scale divisions as a convenient number, 3′.64 of arc, has been adopted for the present discussion as constituting a disturbed observation. Previous to July 18, 1840, the declinometer had a different scale, one division being 20″.7, making the corresponding limit for the first month and a half, 10.6 divisions.

All observations therefore differing 8.0 scale divisions from the mean monthly value of their respective hour were marked by a pencil line; a new hourly mean was taken, omitting values so marked, and each observation was again examined with reference to its deviation from this new mean. The process was repeated, when necessary, so that in all cases values differing $8^d.0$ or more from the final mean, were excluded. The last mean thus obtained for each observing hour and each month has been called "the normal." The following tables of normals present the mean monthly declinometer readings for each observing hour, free from all disturbances, deviating either way 3′.64 or more, from the normal position of the magnet for the respective hour, month, and year. The observations having been made at the even Göttingen hours, the local times are 19½ minutes after the even hour.[4] The time given in the tables is mean local time, counting from midnight, or 0^h up to 24^h.

Increase in the scale readings, corresponds to a decrease of westerly declination. The value of one division of scale is 0′.453.

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[1] Observations made at the Magnetical and Meteorological Observatory at Toronto, in Canada, under the superintendence of Colonel Edward Sabine, vol. ii., 1843, 1844, 1845, with abstracts of observations to 1852, inclusive. London, 1853.

[2] Phil. Trans. R. S., 1851, art. v.

[3] Observations made at the Magnetical and Meteorological Observatory at Toronto, in Canada, under the superintendence of Major-General Edward Sabine, vol. iii., 1846, 1847, 1848, with abstracts of observations to 1855, inclusive. London, 1857.

[4] The observations were made at the even Göttingen time, $6^h\ 00^m$, corresponding to $0^h\ 19\frac{1}{2}^m$ of Philadelphia time.

TABLE I.—Normals of the Declinometer Readings for each observing Hour and Month, in the year 1840.

Observations taken 19½ minutes after the hour indicated.

Philadelphia mean time.	0h.	2h.	4h.	6h.	8h.	10h.	Noon.	14h.	16h.	18h.	20h.	22h.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
June[1]	494.4	495.0	497.5	504.0	502.7	493.8	485.5	483.4	487.9	492.8	492.5	493.6
July	497.3	497.2	498.9	504.7	505.5	495.4	484.5	484.0	488.7	493.3	495.5	496.3
August	495.3	495.7	498.8	506.4	509.1	489.4	480.5	481.9	488.2	493.2	494.9	496.1
September[2]	492.5	495.2	496.9	503.2	502.5	490.8	477.3	479.5	488.4	489.9	493.3	492.6
October	492.5	490.4	491.1	489.1	489.2	484.1	478.4	477.3	481.9	486.3	485.9	493.1
November[3]	481.1	480.6	482.9	483.7	486.4	481.7	474.2	472.5	477.5	480.8	483.6	482.7
December	477.9	475.2	479.8	479.5	480.5	480.6	470.7	471.6	472.7	478.5	479.0	481.2
Mean	490.14	489.90	492.27	495.80	496.56	487.86	478.73	478.60	483.61	487.83	489.24	490.80
Correction[4]	+5.21	5.10	5.33	4.68	5.17	5.85	5.05	4.65	4.46	4.36	4.75	5.25
Mean for '40	495.35	495.00	497.60	500.48	501.73	493.71	483.78	483.25	488.07	492.19	493.99	496.05
Correction for index[5]	+93.30											
Cor. mean for 1840.	588.65	588.30	590.90	593.78	595.03	587.01	577.08	576.55	581.37	585.49	587.29	589.35

TABLE II.—Normals of the Declinometer Readings for 1841.

Value of 1 div. = 0′.453. Time 19½ minutes later than indicated.

Philadelphia mean time.	0h.	2h.	4h.	6h.	8h.	10h.	Noon.	14h.	16h.	18h.	20h.	22h.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
January	579.3	577.0	578.6	576.9	580.7	581.9	570.0	568.8	570.3	574.2	578.0	580.1
February	575.0	573.2	575.6	577.8	582.1	479.5	569.5	566.0	569.5	572.4	574.4	575.8
March	577.1	577.6	580.9	582.9	586.8	578.9	569.4	567.7	571.8	576.4	577.4	577.7
April	580.0	581.9	582.9	585.6	587.6	579.4	568.8	566.1	571.7	576.9	578.0	579.1
May	579.1	579.8	581.9	587.4	589.1	578.6	569.4	567.9	573.6	577.4	578.5	580.1
June	571.7	572.2	574.7	583.3	582.6	571.1	561.6	560.3	565.0	570.1	570.9	570.8
July	569.9	568.5	571.6	578.4	581.2	571.8	558.9	557.3	562.3	567.2	568.8	568.6
August	568.4	570.3	571.6	580.1	583.9	568.9	558.3	556.9	564.0	566.8	568.6	568.9
September	565.1	564.5	565.5	569.4	571.1	564.1	553.6	554.5	559.5	562.9	563.8	564.0
October	566.8	566.3	565.5	567.6	569.4	568.2	564.0	562.3	564.7	573.5	568.6	569.3
November	557.2	558.5	558.5	557.6	561.7	557.1	551.8	549.9	553.4	554.9	558.0	558.6
December	560.1	559.3	560.5	559.6	560.1	558.1	552.9	551.7	555.8	559.6	563.3	561.6
Mean	570.81	570.76	572.32	575.55	578.03	571.47	562.35	560.78	565.13	569.36	570.70	571.22

[1] The readings from June 1st to July 18th, 15 hours, on the College building scale, were converted into observatory scale readings by subtracting 144d.7 at division 628.8 of the old scale, and converting the value of a division 0′.345 of the old into the corresponding reading for the value of a division 0′.453 of the new scale. The mean readings, thus corrected, of the first 18 days of July were then properly combined with the mean of the remaining days of the month.

[2] In the month of September, hour 8, the comparisons were made with the half monthly means, owing to the rapid change of the readings.

[3] On the 23d of November the index of the declinometer bar shifted 19.5 scale divisions; a correction of +19d.5 has, therefore, been added to observations after this date, and, likewise, to all the readings of the following month.

[4] The corrections here given for referring the mean of the last seven months of the year to the mean for the whole year, are derived from the normals of the following year 1841 by comparing the mean of the same seven months with the annual mean of that year. Comparing the same months in the two years the character of the changes appears to be about the same.

[5] A further correction for change in the zero of the scale required to refer the readings of 1840 to the readings of subsequent years. Owing to a rearrangement of the instruments on January 7, 1841, the scale readings changed 112.8 divisions, and since 19.5 scale divisions had been added to the December readings, the resulting correction is the difference of the two, or +93d.30.

In general during the year 1841 the readings are more changeable than during the following years.

The rearrangement of the instruments, and consequent shifting of the index of the scale, alluded to in the preceding notes, interrupted the observations between January 1 and January 12.

The normal for October, 14^h, was obtained by comparing with the half monthly means and taking the mean of the two results as in a similar case for the month of September of the previous year.

TABLE III.—Normals of the Declinometer Readings for 1842.

Value of 1 div. = 0′.453. Time 19½ minutes later than indicated.

Philadelphia mean time.	0h.	2h.	4h.	6h.	8h.	10h.	Noon.	14h.	16h.	18h.	20h.	22h.
	d.	d.	d.	d.	d.	d.	d.	d	d.	d.	d.	d.
January	564.3	563.8	565.3	565.9	570.9	566.4	556.7	556.0	562.9	563.2	566.1	567.8
February	564.5	564.3	563.8	565.2	567.8	565.5	558.2	559.9	558.0	561.9	565.3	565.5
March	564.8	564.1	565.4	566.1	571.8	565.9	555.6	553.9	556.4	560.3	564.5	564.9
April	563.3	565.4	566.1	568.5	569.7	563.6	554.0	552.5	555.1	560.6	561.3	563.0
May	563.3	564.3	566.0	571.2	569.5	560.0	552.6	552.3	557.7	560.8	561.8	562.3
June	564.6	563.7	567.2	573.7	573.0	565.2	555.1	552.5	558.3	561.8	563.7	564.1
July	566.0	566.0	568.4	576.6	576.4	565.8	556.3	553.8	558.5	562.4	564.2	567.1
August	564 8	566.0	568.5	573.7	575.0	560.0	552.3	553.7	561.5	562.2	564.1	564.5
September	567.4	567.8	570.0	576.8	574.9	561.2	556.0	555.4	562.0	565.7	566.7	566.6
October	563.1	563.1	564.4	566.0	568.8	564.0	556.0	555.0	558.2	564.3	565.0	565.3
November	564.2	563.8	565.6	566.9	569.2	563.3	556.6	557.3	561.2	564.0	565.5	565.0
December	561.7	5 0.7	562.1	562.7	565.5	564.2	556.6	556.2	560.1	562.0	563.5	563.8
Mean	564.33	564.42	566.07	569.44	571.04	563.76	555.50	554.54	559.16	562.42	564.31	564.99

TABLE IV.—Normals of the Declinometer Readings for 1843.

Value of 1 div. = 0′.453. Time 19½ minutes later than indicated.

Philadelphia mean time.	0h.	2h.	4h.	6h.	8h.	10h.	Noon.	14h.	16h.	18h.	20h.	22h.
	d.	d.	d.	d.	d.	d.	d.	d	d.	d.	d.	d.
January	...	...	...	...	...	...	...	555.4	...	...	...	...
February	...	...	...	...	...	...	...	555.9	...	...	...	...
March	...	...	...	...	...	...	...	557.2	...	...	...	...
April	569.7	570.0	571.0	574.7	576.2	566.2	557.8	555.7	562.6	564.8	568.5	568.7
May	567.0	567.3	569.6	574.6	575.6	565.7	556.0	556.2	562.2	566.4	566.9	567.3
June	566.0	565.6	568.4	574.1	573.9	564.8	556.4	556.0	561.1	564.3	564.0	565.6
July	566.9	565.9	568.2	574.2	574.6	564.5	555.1	554.1	559.5	563.6	563.8	565.6
August[1]	564.2	564.5	567.2	573.5	572.7	560.5	555.1	554.6	561.2	563.6	562.3	564.2
September	560.4	560.4	560.3	565.7	566.6	554.6	547.5	550.5	556.8	558.0	560.0	558.7
October	559.6	559.6	559.9	562.1	566.0	560.8	553.6	552.7	556.2	558.2	560.1	559.7
November	556.3	556.6	557.4	559.1	561.3	556.2	550.4	551.1	553.8	556.3	557.5	557.3
December	559.0	557.4	557.8	560.0	561.2	559.9	552.9	550.9	554.6	558.2	559.6	559.9
Mean	563.23	563.03	564.42	568.67	569.79	561.47	553.42	554.19	558.67	561.50	562.52	563.00
Correction[2]	+0.06	—0.11	—0.41	—1.24	—0.30	+0.63	+0.44	...	—0.02	—0.23	+0.33	+0.35
Cor'd mean	563.29	562.92	564.01	567.43	569.49	562.10	553.86	554.19	558.65	561.27	562.85	563.35

[1] The suspension threads of the declinometer gave way on the 9th of August, and again on the 10th of January, 1844, but after readjusting the instruments, the magnet returned almost exactly to its former reading—a mean of the two changes gave as a correction +18.7 divisions, which was accordingly added to all the readings of the year after August 9th, 21 hours.

[2] The correction to refer the mean of the nine last months to the mean of all the months is derived from the readings of the preceding year, as being more uniform in character than those for the year following.

The hourly readings commence on October 1, and are continued to the close of the series.

To make the readings of the odd hours of the months of October, November, and December comparable with those of the even hours during the whole year, the means of the even hours for the months of October, November, and December (1843) were compared with the corrected annual means respectively, which gave the corrections for the even hours; and the corrections for intermediate odd hours were obtained from those of the nearest even hours. The deductions from the series of observations at odd hours have but one-third of the weight of those obtained from the even series.

TABLE IV. (*b*).—Additional Normals for the odd hours of the Months of October, November, and December, 1843.

Value of 1 div. = 0′.453. Time 19½ minutes later than indicated.

Philadelphia mean time.	1h.	3h.	5h.	7h.	9h.	11h.	13h.	15h.	17h.	19h.	21h.	23h.
	d.	d	d	d.	d.	d.	d.	d.	d.	d.	d.	d.
October	560.2	559.1	560.6	565.1	565.0	556.5	552.6	554.2	557.0	559.7	561.1	560.7
November	556.7	556.6	557.4	561.8	560.1	552.6	550.0	552.6	554.9	557.5	557.7	557.4
December	558.1	558.2	558.8	560.8	561.9	556.7	551.4	553.1	557.5	558.9	560.0	559.5
Mean	558.33	557.97	558.93	562.57	562.33	555.27	551.33	553.30	556.47	558.70	559.60	559.20
Correction	+5.01	+5.37	+6.36	+6.84	+4.92	+2.37	+2.09	+3.20	+3.74	+3.74	+4.08	+4.70
Cor'd mean	563.34	563.34	565.29	569.41	567.25	557.64	553.42	556.50	560.21	562.44	563.68	563.90

TABLE V.—Normals of the Declinometer Readings for 1844.

Value of 1 div. = 0′.453. Time 19½ minutes later than indicated.

Philadelphia mean time.	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.
	d.	d.	d.	d.	d.	d	d.	d.	d.	d.	d.	d.
January	558.6	558.2	558.4	559.2	558.9	558.8	559.7	561.2	562.9	563.3	559.1	555.9
February	559.1	558.5	559.1	559.2	559.9	561.1	560.8	562.1	562.2	560.7	557.3	554.5
March	558.0	559.0	559.2	557.9	559.8	560.2	561.3	563.6	564.8	564.1	560.3	554.9
April	556.6	557.0	557.2	556.9	557.5	558.4	561.7	558.5	564.4	561.8	557.1	552.0
May	548.4	548.7	547.8	547.0	549.3	552.5	555.8	556.8	555.1	552.3	546.7	542.2
June	548.7	549.0	549.3	549.1	551.6	553.9	557.6	559.1	558.2	554.3	547.9	541.8
July	549.0	550.5	548.4	549.4	551.0	554.3	556.9	559.8	558.6	554.8	548.0	540.8
August	548.6	547.8	547.3	547.4	550.9	552.4	557.5	560.3	558.2	551.8	543.3	536.4
September	543.3	543.1	544.1	546.0	546.5	547.1	550.0	552.9	552.4	545.8	538.3	532.5
October	545.1	545.3	544.2	546.1	545.8	544.4	548.6	550.9	551.5	548.7	545.3	540.8
November	546.8	546.8	548.3	548.6	547.4	548.5	551.5	549.2	548.4	547.9	546.2	542.8
December	536.1	535.8	535.4	535.9	536.8	537.3	537.2	536.8	537.9	539.3	536.1	532.9
Mean	549.86	549.98	549.89	550.23	551.28	552.41	554.88	555.93	556.22	553.73	548.80	543.96

Philadelphia mean time.	Noon.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.
	d.	d.	d	d.	d.	d.	d	d.	d.	d.	d.	d.
January	552.9	552.4	553.2	554.1	556.3	556.9	557.8	559.2	559.5	560.9	560.8	559.6
February	551.1	551.1	553.0	554.7	556.4	556.6	557.6	558.4	559.9	559.4	560.1	559.0
March	550.6	549.4	549.6	551.7	553.0	555.2	556.6	558.0	558.4	558.2	558.6	559.7
April	547.4	545.7	546.2	547.6	549.6	553.4	553.4	553.8	556.2	555.1	555.7	559.3
May	538.3	535.8	536.5	538.9	542.1	545.1	545.2	546.5	546.3	547.3	547.3	547.8
June	537.4	535.0	537.3	540.0	542.4	545.2	545.6	546.2	546.5	546.8	548.0	548.5
July	538.3	535.5	536.3	538.8	541.9	544.5	545.8	546.2	546.6	547.4	548.8	549.3
August	531.8	532.0	534.3	538.7	542.1	544.3	546.0	546.5	546.7	546.6	547.8	547.7
September	529.3	530.0	534.1	538.3	539.4	541.9	542.4	541.9	543.0	544.6	543.7	543.3
October	541.1	539.5	541.4	544.0	545.7	545.4	545.6	545.0	544.9	544.6	544.5	544.6
November	542.8	541.7	544.5	546.1	545.6	547.9	548.8	548.2	548.3	549.6	548.0	548.0
December	530.6	529.3	529.4	532.1	533.2	534.8	535.9	537.0	536.8	537.4	537.8	537.1
Mean	540.97	539.78	541.32	543.75	545.64	547.60	548.44	548.91	549.43	549.83	550.10	550.33

To the observations between January 1 and January 10 a correction of $+18^{d}.7$ was applied, as explained in the preceding note.

In the month of December the declination changed so rapidly as to require the use of half monthly means; the mean of the two results is inserted in the above table.

TABLE VI.—Normals of the Declinometer Readings for 1845.

Value of 1 div. = 0′.453. Time $19\frac{1}{2}$ minutes later than indicated.

Philadelphia mean time.	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
January	530.9	531.3	531.1	531.5	533.0	531.6	532.9	535.2	535.8	533.8	530.2	526.7
February	531.6	531.1	531.0	532.4	532.3	533.1	534.7	535.9	535.7	535.4	533.0	528.6
March	532.9	532.7	533.7	533.6	535.0	533.9	536.0	538.8	539.4	538.6	534.5	529.4
April	529.1	528.8	529.0	529.2	529.8	531.7	534.0	535.6	537.5	535.4	528.5	522.5
May	529.9	531.3	529.7	531.7	533.2	536.3	539.3	541.9	540.7	536.0	528.0	522.6
June	531.5	531.7	531.6	532.0	534.8	537.9	541.9	543.5	542.5	538.6	532.2	524.9
Mean	530.98	531.15	531.02	531.73	533.02	534.08	536.47	538.48	538.60	536.30	531.07	525.78
Correction[1]	—2.42	—2.50	—2.58	—2.41	—2.26	—2.03	—1.81	—2.01	—2.21	—2.76	—3.30	—2.94
Cor'd mean	528.56	528.65	528.44	529.32	530.76	532.05	534.66	536.47	536.39	533.54	527.77	522.84

Philadelphia mean time.	Noon.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
January	524.2	525.2	526.2	528.0	530.1	531.8	532.7	532.8	533.3	533.0	532.4	532.0
February	524.4	523.0	525.3	527.5	529.7	530.4	532.4	531.3	533.6	534.4	532.3	531.9
March	524.8	522.5	522.8	524.8	527.8	529.7	531.6	533.0	533.0	533.8	533.5	534.0
April	517.8	513.9	514.0	517.2	521.5	525.8	527.8	527.9	528.1	528.5	528.0	529.4
May	517.1	516.8	518.9	522.1	526.7	529.3	529.6	530.4	529.7	530.3	530.5	530.3
June	521.3	519.6	520.0	522.1	525.4	528.9	530.3	530.7	530.1	530.7	530.3	531.4
Mean	521.60	520.17	521.20	523.62	526.87	529.32	530.73	531.02	531.30	531.78	531.17	531.50
Correction[1]	—2.59	—2.28	—1.98	—1.80	—1.62	—1.64	—1.65	—1.99	—2.23	—2.36	—2.47	—2.44
Cor'd mean	519.01	517.89	519.22	521.82	525.25	527.68	529.08	529.03	529.07	529.42	528.70	529.06

For the purpose of comparing the annual means of the normals, or the mean march of the regular solar-diurnal variation for each year, the preceding results have been expressed analytically by means of Bessel's formula, and by the application of the method of least squares.

In these formulæ the angle θ is reckoned from midnight (Philadelphia), at the rate of 15° for each following hour. It was found unnecessary to carry the expressions beyond the third term, the fourth being generally smaller than the probable error of an hourly normal. We obtain accordingly—

$$\text{For 1840}\quad D = 586.73^{d} + 6.214^{d}\sin(\theta + 36^\circ\,35') + 4.588^{d}\sin(2\theta + 217^\circ\,33') + 1.640^{d}\sin(3\theta + 68^\circ\,50')$$

$$\text{“ 1841}\quad D = 569.87 + 4.888\sin(\theta + 30\ 05) + 4.380\sin(2\theta + 212\ 38) + 1.581\sin(3\theta + 50\ 14)$$

$$\text{“ 1842}\quad D = 563.33 + 4.944\sin(\theta + 33\ 49) + 4.211\sin(2\theta + 217\ 12) + 1.463\sin(3\theta + 64\ 42)$$

$$\text{“ 1843}\quad D = 562.01 + 4.449\sin(\theta + 36\ 00) + 3.918\sin(2\theta + 218\ 05) + 1.811\sin(3\theta + 68\ 18)$$

$$\text{“ 1844}\quad D = 548.89 + 4.486\sin(\theta + 34\ 35) + 3.872\sin(2\theta + 222\ 23) + 1.802\sin(3\theta + 68\ 53)$$

$$\text{“ 1845}\quad D = 528.12 + 4.548\sin(\theta + 35\ 33) + 4.872\sin(2\theta + 225\ 35) + 1.987\sin(3\theta + 61\ 20)$$

[1] As indicated by the annual change in the readings, it was considered preferable to obtain the annual mean by deducing the correction to the mean of the first six months, from the readings of the preceding year and those of the year 1842.

Owing probably to the several accidental changes in the suspension of the bar, and consequent uncertainty in the precise amount of scale correction, the mean readings of each year, when compared with one another, exhibit differences not actually due to inequalities occasioned by declination changes. This question, however, does not directly bear upon the present investigation, which mainly depends on differences of readings, and it is proper to remark that the observed increase, giving the weight one-half to the mean of 1840 and of 1845, is under the supposition of a uniform annual change between these years, equal to 4′.50. From Mr. Schott's investigation[1] of the secular change of the declination at Philadelphia, supported by observations between the years 1701 and 1855, the annual increase between the years 1840 and 1845 is 4′.98, a result which accords tolerably well with actual observations. According to his formula, the declination on the first of January, 1843, the mean epoch of the present series was 3° 32′ west, with a probable error of ± 10′, which corresponds to the scale reading 560.31, deduced by taking into account the weights of the annual means.

We now proceed to the investigation of the inequality in the diurnal variation, changing the preceding formulæ for greater convenience into the following:—

For 1840 $\Delta = +2'.815\ sin\ (15°n + 36°\ 35') + 2'.078\ sin\ (30°n + 217°\ 33') + 0'.743\ sin\ (45°\ n + 68°\ 50')$
" 1841 $\Delta = +2.214\ sin\ (15\ n + 30\ 05) + 1.984\ sin\ (30\ n + 212\ 38) + 0.716\ sin\ (45\ n + 50\ 14)$
" 1842 $\Delta = +2.240\ sin\ (15\ n + 33\ 49) + 1.908\ sin\ (30\ n + 217\ 12) + 0.663\ sin\ (45\ n + 64\ 42)$
" 1843 $\Delta = +2.015\ sin\ (15\ n + 36\ 00) + 1.775\ sin\ (30\ n + 218\ 05) + 0.820\ sin\ (45\ n + 68\ 18)$
" 1844 $\Delta = +2.032\ sin\ (15\ n + 34\ 35) + 1.754\ sin\ (30\ n + 222\ 23) + 0.816\ sin\ (45\ n + 68\ 53)$
" 1845 $\Delta = +2.060\ sin\ (15\ n + 35\ 33) + 2.206\ sin\ (30\ n + 225\ 35) + 0.900\ sin\ (45\ n + 61\ 20)$

Where Δ = the regular solar-diurnal variation.
n = the number of hours after midnight.

To show the agreement between these expressions and the corresponding observed quantities, and to exhibit to the eye the character of the diurnal variation, the results have been thrown into curves. The observed bi-hourly means are represented in Fig. 2 (p. 11) by dots, and in no instance do they differ from the computed values by as much as 0^d.8 or 0′.3. As a specimen of the representation, I add the results for the year 1845:—

Hour.	Observed value.	Computed value.	C—O.	Hour.	Observed value.	Computed value.	C—O.
h. m.	d.	d.	d.	h. m.	d.	d.	d.
0 19½	528.56	528.99	+.43	12 19½	519.01	519.23	+.22
2 19½	528.44	528.48	+.04	14 19½	519.22	518.96	—.26
4 19½	530.76	530.26	—.50	16 19½	525.25	525.18	—.07
6 19½	534.66	535.11	+.45	18 19½	529.08	529.15	+.07
8 19½	536.39	535.97	—.42	20 19½	529.07	529.07	.00
10 19½	527.77	528.18	+.41	22 19½	528.70	528.86	+.16

The average probable error of any single representation by the formula is $\pm 0^d.22$ or $\pm 0'.10$.

By means of the preceding formulæ the following values were computed: 1. The time when the north end of the magnet reached its extreme eastern position, or, in other words, the epoch of the eastern elongation. 2. The corresponding maximum scale reading, or, more properly, the corresponding minimum of western declination. 3. The time of the occurrence of the western elongation; and 4. The corresponding

[1] Report on the progress of the U. S. Coast Survey for 1855, Appendix, No. 48, and an Appendix (p. 11) of the report for 1859.

maximum reading of western declination. In the last two columns the difference of the scale readings, or the amplitude of eastern and western elongation, is made out in scale divisions, and also in minutes of arc.

The inequality of this amplitude next requires our attention.

For	Epoch of eastern deflection.	Corresponding scale reading.	Epoch of western deflection.	Corresponding scale reading.	Amplitude.	
	h. m.	d.	h. m.	d.	d.	′
1840	7 26 A. M.	595.67	1 34 P. M.	575.71	19.96	9.08
1841	7 49	577.96	1 49	560.21	17.75	8.06
1842	7 36	571.24	1 37	553.96	17.28	7.83
1843	7 40	569.54	1 24	553.06	16.48	7.46
1844	7 32	556.50	1 18	539.99	16.51	7.51
1845	7 34	536.65	1 16	517.81	18.84	8.53
Mean	7 36 A. M. ±3		1 30 P. M. ±4			

The inequality constituting the ten or eleven year period is plainly exhibited in the last two columns of the above table, the progression in the numbers being quite regular. The year 1843 is clearly indicated as the year of the minimum range of the diurnal fluctuation, but whether the period is one nearer to ten or to eleven years cannot be decided from the Girard College observations, since they do not embrace a year of maximum amplitude. The epoch of the minimum, however, can be determined with more precision. For this purpose only, the values in the last column are represented by the formula,

$$A = 9'.08 - 1'.14\ (t - 1840.5) + 0'.201\ (t - 1840.5)^2,$$

deduced by the method of least squares, and the quantities come out as follows:—

Year.	Observed amplitude.	Computed by formula.	Difference.	Year.	Observed amplitude.	Computed by formula.	Difference.
1840.5	9′.08	9′.08	0′.00	1843.5	7′.46	7′.47	—0′.01
1841.5	8.06	8.14	—0.08	1844.5	7.51	7.74	—0.23
1842.5	7.83	7.60	+0.23	1845.5	8.53	8.41	+0.12

Probable error of any single amplitude, ±0′.11.

That portion of the ten or eleven year period which results from the preceding discussion of the differential observations of the magnetic declination, free from the effect of the disturbances as far as the latter can be eliminated, is shown graphically in Fig. 1.

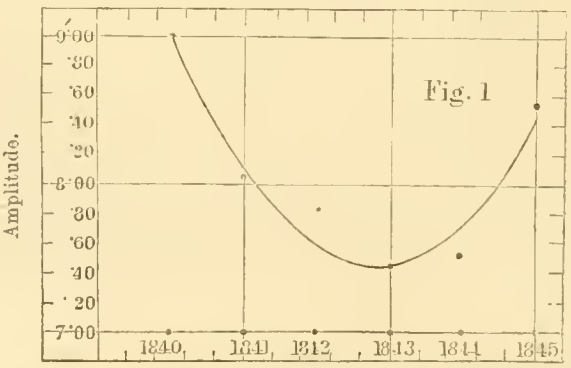
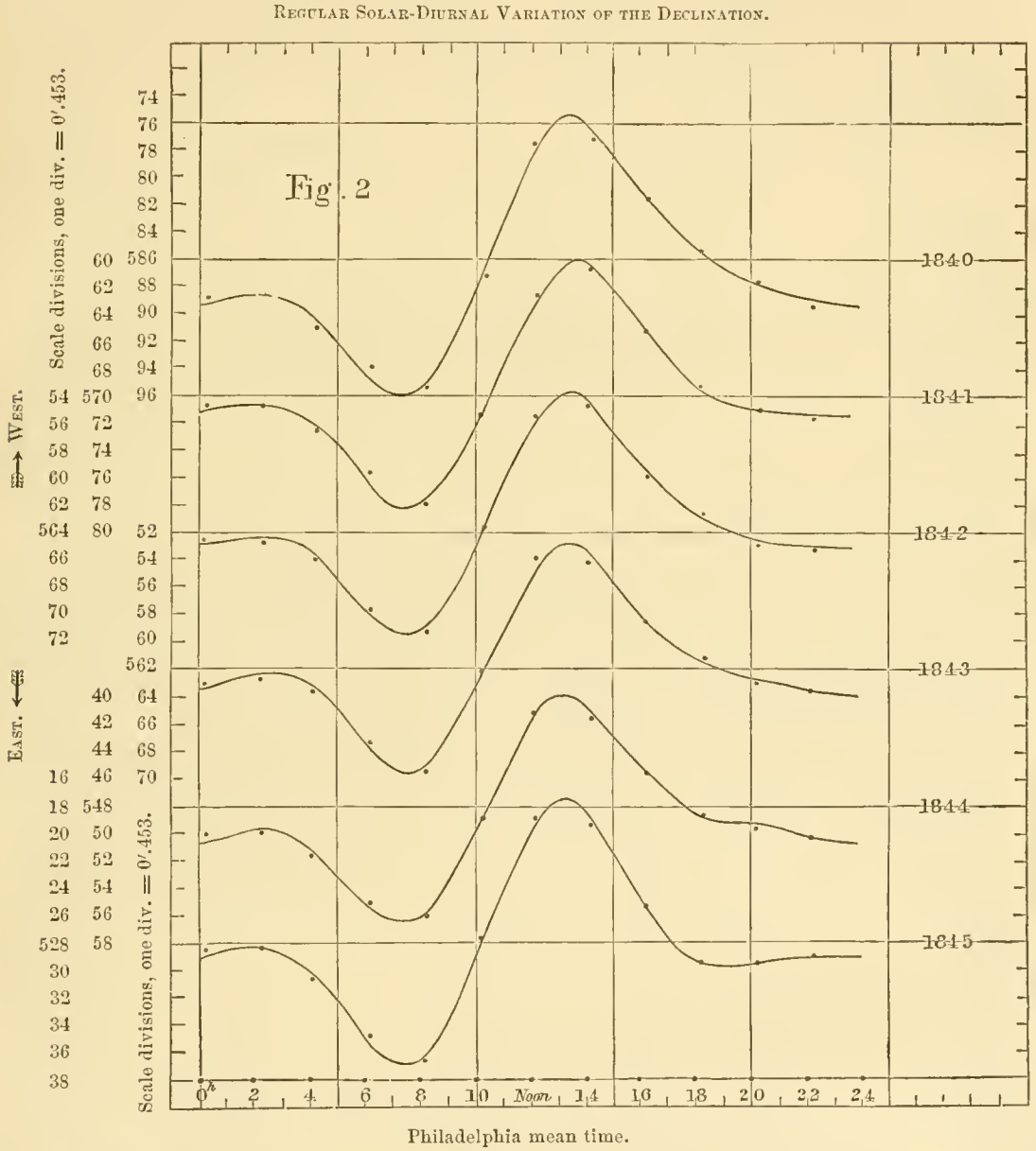


Fig. 1

The month of May, in the year 1843, is indicated by the formula as the epoch of the minimum amplitude.



We now proceed to the discussion of the disturbances as far as they bear on the decennial inequality, taking in also some collateral results.

The total number of observations for changes of declination recorded and discussed amounts to 24,566; of these, 2357 were separated as disturbances differing eight scale divisions or more from their respective normals, leaving 22,209 observations, from which the preceding results were deduced. There is one disturbed observation in every 10.4 observations.

The discussion of the disturbances divides itself into two parts, that of the number and that of the amount of the larger deflections.

Owing to partial incompleteness in the number of observing months in some years, it became necessary to fill out the number for the annual inequality from the results of the complete years. Their number for each month in the complete years is given in the following table, the numbers for 1844 having first been divided by two, in order to make the hourly observations comparable with the bi-hourly in the years 1841 and 1842:—

Month.	1841.	1842.	1844.	Mean.	Ratio.
January	33	44	5	27	0.75
February	25	26	5	19	0.53
March	26	24	24	25	0.70
April	25	31	39	32	0.89
May	33	14	17	21	0.58
June	31	30	7	23	0.64
July	30	40	15	28	0.78
August	49	64	44	52	1.45
September	57	60	31	49	1.36
October	94	86	53	78	2.17
November	81	22	42	48	1.33
December	55	5	26	29	0.82
Sum	539	446	308	431	12.00
Mean				36	1.00

The last column contains the ratio of the mean monthly value to the mean annual value. By means of these ratios, and using the observed monthly values in each defective year, the numbers in the following table were filled up, all the deduced values being indicated by brackets. As in the preceding table, the values refer or were made to refer to bi-hourly observations:—

Table showing the Number of Disturbances in each Month of the Years 1840 to 1845.

Month.	1840.	1841.	1842.	1843.	1844.	1845.	Mean.	Ratio.
January	(30)	33	44	(17)	5	19	25	0.77
February	(21)	25	26	(12)	5	13	17	0.52
March	(28)	26	24	(16)	24	14	22	0.68
April	(36)	25	31	21	39	22	29	0.91
May	(24)	33	14	15	17	11	19	0.58
June	8	31	30	12	7	12	17	0.53
July	44	30	40	20	15	(17)	28	0.86
August	40	49	64	80	44	(32)	51	1.59
September	56	57	60	27	31	(30)	44	1.36
October	94	94	86	16	53	(48)	68	2.12
November	19	81	22	8	42	(28)	35	1.08
December	83	55	5	4	26	(18)	32	1.00
Sum	344	539	446	230	308	91	387	12.00
Corrected sum and mean	483			275		264	32	1.00

The ratios in the last column show the annual inequality in the distribution of the disturbances. The principal maximum occurs in October,[1] the secondary in April; the two minima, nearly of equal amount, occur in the months of February and June. The progression of the numbers is regular.

[1] At Toronto this maximum occurred in September; the first minimum is likewise one month earlier at this station than at Philadelphia.

If we separate the numbers in accordance with westerly and easterly deflections we obtain the following table, deduced as in the former case. It may be remarked that on account of the separate ratios used for the interpolation of the western and eastern deflections, their sum in any one month does not give the corresponding number in the above table exactly, only the yearly sums having been preserved; and the same is true in regard to the table, showing the amount of the disturbances. Interpolated values as before are inclosed between brackets:—

Month.	1840.		1841.		1842.		1843.		1844.		1845.		Sums.		Ratios.	
	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.
January	(36)	(2)	25	8	35	9	(22)	(7)	2	3	10	9	130	38	1.27	0.42
February	(17)	(3)	9	16	17	9	(13)	(9)	3	2	11	2	70	41	0.70	0.46
March	(23)	(5)	11	15	17	7	(15)	(6)	10	14	9	5	85	52	0.83	0.57
April	(27)	(5)	10	15	14	17	7	14	25	14	15	7	98	72	0.95	0.80
May	(17)	(4)	18	15	8	6	7	8	4	13	3	8	57	54	0.55	0.60
June	3	5	15	16	17	13	2	10	3	4	5	7	45	55	0.44	0.61
July	17	27	5	25	14	26	11	9	6	9	(7)	(11)	60	107	0.58	1.18
August	20	20	18	31	55	9	67	13	25	19	(20)	(11)	205	103	2.00	1.14
September	36	20	14	43	11	49	6	21	18	13	(11)	(21)	96	167	0.93	1.86
October	68	26	34	60	17	69	6	10	23	30	(15)	(30)	163	225	1.58	2.50
November	11	8	41	40	11	11	5	3	16	26	(15)	(14)	99	102	0.96	1.12
December	77	6	24	31	1	4	2	2	12	14	(8)	(10)	124	67	1.21	0.74
Sum	232	112	224	315	217	229	113	90	147	161	53	38	1232	1083	12.00	12.00
Corrected mean	352	131	...	...	...	...	163	112	...	...	129	135	...	...	...	...
Total	483		539		446		275		308		264		2315		...	

The ratios show a general correspondence in the numbers of westerly and easterly deflections; the westerly deflections seem to occur most frequently in August, while the easterly predominate in October; the secondary maximum of either series is in April. The minima remain nearly as before, one minimum of eastern deflection occurring in January.

With respect to the whole number of westerly and easterly deflections, we deduce the proportional sums from the following table:—

Year.	W.	E.	Sum.	
1840	352	131	483	Weight $\frac{1}{2}$
1841	224	315	539	
1842	217	229	446	
1843	163	112	275	Weight $\frac{3}{4}$
1844	147	161	308	
1845	129	135	264	Weight $\frac{1}{2}$
Sum	1232	1083	2315	
Proportional sums by weight	937	912		

On account of the incompleteness of the record in the years 1840, 1843, and 1845, the number of eastern and western disturbances relative to the total number cannot be ascertained with accuracy. They are about equal in the record. At Toronto the eastern predominate over the western in the proportion of 1.17 to 1 (for the years 1841 to 1848), and nearly to the same extent for each year, taken separately.

The numbers in the column headed "sum" do not indicate the law of the eleven

year period as plainly and systematically as did the investigation of the diurnal amplitude; yet giving half weight, on account of the want of record, to the sums for 1840 and 1845, the minimum number falls in the year 1843. More consistent results would, no doubt, have been obtained if the year 1845 had been complete.

If we distribute the disturbances (1942 in number for the even hours) according to their respective hours of occurrence, the following table results from observations between 1840 and 1845:—

Add 19½ m.	W.	E.	Sum.	Ratios.		Add 19½ m.	W.	E.	Sum.	Ratios.	
				W.	E.					W.	E.
0h.	67	95	162	0.82	1.20	Noon	93	57	150	1.13	0.71
2	97	92	189*	1.18	1.16	14h.	79	54*	133*	0.95	0.67*
4	89	79	168	1.08	0.96	16	88	60	148	1.07	0.78
6	110*	63	173	1.35*	0.80	18	72	71	143	0.87	0.90
8	105	56	161	1.29	0.70	20	34*	133*	167	0.40*	1.66*
10	107	71	178	1.32	0.88	22	45	125	170	0.54	1.58

Maxima and minima values are distinguished by an asterisk.

The numbers in each vertical column show a regular progression; and the number of disturbances, irrespective of their direction, have a minimum at 2 P. M. and a maximum at 2 A. M.[1] The principal contrast is between the hours of the day and the hours of the night; in the former case the numbers being below, but in the latter above the mean value. This is in close correspondence with the Toronto results. The most striking result of the above table is—that the westerly disturbances have their minimum precisely at the hour (8 P. M.) when the easterly have their maximum value; and the exact coincidence of this result with that deduced by General Sabine for Toronto is not less remarkable. For the westerly disturbances, the hours 6 A. M. (maximum) and 8 P. M. (minimum), and for the easterly disturbances the hours 2 P. M. (minimum) and 8 P. M. (maximum), are specially contrasted. These results also agree with those found at Toronto; and the accordance with that station even goes so far as to exhibit the secondary minimum of eastern disturbances at 8 A. M. In connection with this subject it may be here stated, that the same distinguished magnetist found a singular mutual relation to subsist between the phenomena at Toronto and Point Barrow, on the shores of the Arctic Sea—the laws of the easterly deflection at one station being found to correspond for the same local hours, with those of the westerly deflections at the other station, and *vice versâ*. This contrast holds good for Philadelphia as well as for Toronto.

We now pass to the consideration of the amount of deflections caused by the disturbances, classifying the same according to years, months, and hours:—

[1] At Toronto the respective hours are 2 P. M. and 22 P. M.

Aggregate Values of the Disturbances, and Mean Values in the Different Years.

Year.	Aggregate values.	Same corrected to 12 months.	Number.	Average value of a disturbance.	Same in minutes of arc.	Same at Toronto for comparison.
	d.	d.		d.	′	′
1840	5140.0 (7 months)	7155.5	483	14.8	6.70	...
1841	7844.4	7844.4	539	14.6	6.61	6.34
1842	6019.1	6019.1	446	13.5	6.11	5.90
1843	2465.7 (9 months)	2932.2	275	10.7	4.85	5.62
1844	4227.3	4227.3	308	13.7	6.21	6.49
1845	1138.6 (6 months)	3521.4	264	13.3	6.02	5.84

The table includes only the series of bi-hourly observations; the reduction of the numbers from incomplete years to the correct sum for the whole year being effected by means of ratios as in the discussion of the number of disturbances. For comparison the average value of a disturbance at Toronto is added. It must be remarked, that the amount of deviation from the normal, constituting a disturbance, was nearly but not quite the same at Toronto as at Philadelphia, so that the ratios of the corresponding numbers in the last two columns should be compared.

The eleven year period is well marked in the aggregate value of the disturbances, as well as in their average value in the different years; and the year 1843 is decidedly indicated as the minimum. To find a more precise value for the epoch of the minimum, the formula,

$$\delta = 7'.09 - 0'.930\,(t - 1840.5) + 0'.149\,(t - 1840.5)^2,$$

has been constructed, which represents the observed values as follows:—

Year.	Observed amount.	Computed amount.	Difference.	Year.	Observed amount.	Computed amount.	Difference.
1840.5	6′.70	7′.09	+0′.39	1843.5	4′.85	5′.64	+0′.79
1841.5	6.61	6.31	—0.30	1844.5	6.21	5.75	—0.46
1842.5	6.11	5.83	—0.28	1845.5	6.02	6.16	+0.14

The first and last value have only half weight. According to the formula, the minimum took place in August, 1843. (See Fig. 3.)

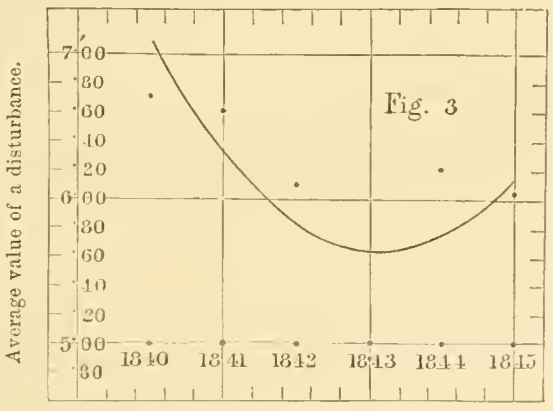


Fig. 3

As the resulting epoch from the differential observations with the declinometer we find the month of June, 1843, by giving double weight to the result deduced from the inequality of the diurnal amplitude.

Separating into western and eastern disturbances we find—

Year.	West Deflections.			East Deflections.		
	Aggregate value.	n	Average value.	Aggregate value.	n	Average value
	d.		′	d.		′
1840 . . .	5064.8	352	6.52	2090.7	131	7.20
1841 . . .	2935.5	224	5.93	4908.9	315	7.07
1842 . . .	2645.9	217	5.53	3373.2	229	6.70
1843 . . .	1741.6	163	4.85	1190.6	112	4.85
1844 . . .	2019.7	147	6.21	2207.6	161	6.21
1845 . . .	1489.2	129	5.25	2032.3	135	6.84

From which it appears that the easterly values preponderate over the westerly in the ratio of 1.14 to 1. The ratio from the Toronto observations between 1844 and 1848 is 1.28 to 1.

The following table shows the aggregate amount of disturbances in each month of the different years, or the annual inequality of the aggregate disturbances:—

Month.	1840.	1841.	1842.	1843.	1844.	1845.	Mean.	Ratio.
	d.	d.	d.	d.	d.	d.	d.	
January . . .	(418.4)	423.6	585.9	(171.0)	45.3	269.2	318.9	0.72
February . .	(323.0)	402.3	310.1	(131.9)	99.7	160.1	237.8	0.54
March . . .	(400.5)	327.9	264.4	(163.6)	430.0	167.4	292.3	0.66
April	(544.6)	294.7	481.1	281.7	601.5	289.7	415.6	0.94
May	(329.0)	442.8	184.4	206.8	205.5	111.0	246.6	0.56
June	83.1[1]	355.5	353.1	133.9	50.4	141.2	186.2	0.42
July	668.8[1]	416.8	546.8	271.5	168.3	(220.4)	382.1	0.87
August . . .	618.6	823.1	873.5	953.9	552.6	(434.2)	709.3	1.61
September . .	853.5	1242.7	779.9	301.5	448.6	(484.1)	685.0	1.56
October . . .	1319.1	1376.2	1253.2	195.0	668.1	(639.3)	908.5	2.06
November . .	314.6	1054.2	339.3	87.1	591.1	(387.4)	462.3	1.06
December . .	1282.3	684.6	47.4	34.3	366.2	(217.4)	438.7	1.00
Sum	7155.5	7844.4	6019.1	2932.2	4227.3	3521.4	5283.3	12.00

The last column of ratios of the aggregate value of the disturbances of each month to the mean of all, corresponds very closely to the analogous ratios deduced in a preceding table for the number of disturbances, giving the law in reference to the number and amount of disturbances in a year as the same, or nearly so. The maximum amount of disturbances occurs in October (at Toronto in September), the minimum amount in June (the same at Toronto); the secondary maximum occurs in April (as at Toronto), and the secondary minimum in February; but at Toronto in January, from comparison with the years 1843, 1844, 1845.

The next tables give the aggregate monthly values in the six years, separated into west and east deflections:—

[1] The differences of the disturbed readings from their respective normals during the month of June and part of July, 1840, were first converted from the old scale into equivalent new scale values.

West Deflections.

Month.	1840.	1841.	1842.	1843.	1844.	1845.	Mean.	Ratio.
	d.	d.	d.	d.	d.	d.	d.	
January . . .	(495.5)	308.4	444.8	(170.4)	23.8	161.6	267.4	1.21
February . . .	(238.0)	147.2	217.1	(82.0)	28.0	69.9	130.4	0.59
March	(288.7)	127.2	168.5	(99.5)	172.8	117.5	162.4	0.73
April	(432.2)	97.9	216.9	98.9	370.1	171.0	229.5	1.04
May	(212.8)	229.5	84.4	109.7	43.5	8.3	114.7	0.52
June	30.9	170.4	194.2	21.7	12.6	65.9	82.6	0.37
July	186.7	51.1	140.5	153.3	28.9	(42.9)	100.6	0.46
August	275.9	228.4	721.3	809.7	304.5	(247.5)	431.2	1.95
September . .	495.3	257.8	116.7	65.2	249.3	(123.5)	217.9	0.99
October . . .	1019.9	422.5	172.5	74.4	340.3	(185.5)	369.2	1.67
November . . .	178.4	586.9	159.6	39.1	267.1	(196.9)	238.0	1.09
December . . .	1210.5	308.2	9.4	17.7	178.8	(98.7)	303.9	1.38
Sum	5064.8	2935.5	2645.9	1741.6	2019.7	1489.2	2647.8	12.00

East Deflections.

Month.	1840.	1841.	1842.	1843.	1844.	1845.	Mean.	Ratio.
	d.	d.	d.	d.	d.	d.	d.	
January . . .	(27.9)	115.2	141.1	(22.7)	21.5	107.6	72.7	0.33
February . . .	(55.7)	255.1	93.0	(38.5)	71.7	90.2	100.7	0.46
March	(81.8)	200.7	95.9	(53.4)	257.2	49.9	123.2	0.56
April	(116.7)	196.8	264.2	182.8	231.4	118.7	185.1	0.84
May	(66.2)	213.3	100.0	97.1	162.0	102.7	123.6	0.56
June	52.2	185.1	158.9	112.2	37.8	75.3	103.6	0.47
July	482.1	365.7	406.3	118.2	139.4	(177.5)	281.5	1.29
August	342.7	594.7	152.2	144.2	248.1	(194.8)	279.4	1.28
September . .	358.2	984.9	663.2	236.3	199.3	(358.3)	466.7	2.12
October . . .	299.2	953.7	1080.7	120.6	327.8	(453.0)	539.2	2.46
November . . .	136.2	467.3	179.7	48.0	324.0	(187.6)	223.8	1.02
December . . .	71.8	376.4	38.0	16.6	187.4	(116.6)	134.4	0.61
Sum	2090.7	4908.9	3373.2	1190.6	2207.6	2032.2	2633.9	12.00

Maxima in September (mean of August and October) and April; minima in June and January as at Toronto.

The following table gives the aggregate values of the disturbances distributed into the different hours of the day, as deduced from bi-hourly observations made in 1840 to 1845:—

Philadelphia. Hour. (+ 19⅓ m.)	Aggregate Values of Western Deflections, Eastern Deflections, and Sum.			Mean Aggregate Values for one year.			Ratios.		
	W.	E.	Sum.	W.	E.	Sum.	W.	E.	Both combined.
	d.	d.	d.	d.	d.	d.			
0h.	897.4	1438.5	2335.9	149.6	239.8	389.4	0.83	1.24	1.04
2	1259.7	1278.2	2537.9	209.9	213.0	422.9	1.16	1.10	1.13
4	1255.5	1075.5	2331.0	209.2	179.3	388.5	1.16	0.92	1.04
6	1581.7	773.6	2355.3	263.6	128.9	392.5	1.46	0.67	1.06
8	1512.4	769.9	2282.3	252.1	128.3	380.4	1.39	0.67	1.02
10	1315.2	901.9	2217.1	219.2	150.3	369.5	1.22	0.77	0.99
Noon	1114.8	733.2	1848.0	185.8	122.2	308.0	1.03	0.63	0.83
14	1056.4	735.0	1791.4	176.1	122.5	298.6	0.98	0.63	0.80
16	1068.1	825.8	1893.9	178.0	137.6	315.6	0.99	0.72	0.85
18	902.1	965.2	1867.3	150.3	160.9	311.2	0.84	0.89	0.84
20	408.9	2175.4	2584.3	68.2	362.6	430.8	0.38	1.88	1.15
22	610.4	2180.3	2790.7	101.7	363.4	465.1	0.56	1.88	1.25
Sum	12982.6	13852.5	26835.1	2163.7	2308.8	4472.5	12.00	12.00	12.00
Mean	...	...	...	180.3	192.4	372.7	...	...	...

If we compare these ratios with the corresponding numbers in the preceding tables, showing the bi-hourly distribution in regard to the number of disturbances, we find, irrespective of the directions of the deflections, the 2 P. M. minimum preserved; the maximum occurs at 10 P. M. At Toronto, from a five years' hourly series, commencing with 1844, these hours are respectively 1 P. M. and 9 P. M. At Philadelphia, as at Toronto, the ratios are nearly invariable from 10 A. M. to 6 P. M., being then below unity; and again from 8 P. M. to 8 A. M., when they are above unity.

The easterly maximum and the westerly minimum at 8 P. M. appear again as a decided feature, and in general, the respective ratios exhibiting the diurnal distribution of the disturbances, both in an easterly and westerly direction, show almost a perfect correspondence in regard to both number and amount.

The next table exhibits the excess of westerly disturbance over easterly (the sign — indicating a defect, or excess of easterly over westerly) in the aggregate values of the five year series, and in the last column, the mean effect of the same at each even hour, is given as obtained by dividing the aggregate differential value of the preceding column by the actual number of days of observation during the whole period. The last column exhibits, therefore, the mean diurnal disturbance variation. The number of days is very nearly 1500.

Philadelphia mean time.	Excess of westerly over easterly values.	Diurnal Variation caused by the Larger Disturbances.		For comparison: Disturbance—variation at Toronto 1843-'44-'45 (at even hours).	Philadelphia mean time.	Excess of westerly over easterly values.	Diurnal Variation caused by the Larger Disturbances.		For comparison: Disturbance—variation at Toronto 1843-'44-'45 (at even hours).
		In scale divisions.	In minutes of arc.				In scale divisions.	In minutes of arc.	
	d.	d.	′	′		d.	d.	′	′
0h. 19½m.	—541.1	—0.36	—0.16	—0.36	Noon 19½m.	+ 381.6	+0.25	+0.11	+0.09
2 19½	— 18.5	—0.01	—0.01	—0.20	14 19½	+ 321.4	+0.21	+0.10	+0.04
4 19½	+180.0	+0.12	+0.05	—0.03	16 19½	+ 242.3	+0.16	+0.07	+0.03
6 19½	+808.1	+0.54	+0.24	+0.02	18 19½	— 63.1	—0.04	—0.02	—0.16
8 19½	+742.5	+0.50	+0.22	+0.10	20 19½	—1766.5	—1.18	—0.53	—0.56
10 19½	+413.3	+0.28	+0.13	+0.06	22 19½	—1569.9	—1.05	—0.47	—0.75

The law governing the disturbances during a solar day is clearly shown, and systematic in character. If we plot the disturbance curve on the same scale, or actually superpose it on the curves of the regular diurnal variation, the difference would hardly show to the eye. The diagram, showing the disturbance variation, has, therefore, been plotted on a larger scale. (See Fig. 4.)

Diurnal Disturbance Variation of the Declination.

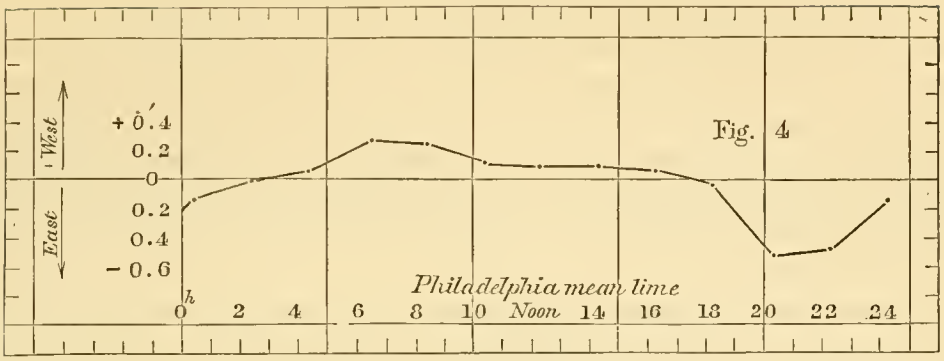


Fig. 4

The curve has but one maximum and one minimum; its most prominent feature is the easterly deflection at 8 o'clock (+19½ᵐ) P. M. (at Toronto it is at 9 P. M.). At that hour the maximum deflection amounts to 32″ of arc, and to 45″ at Toronto. The greatest westerly deflection occurs at 6ʰ (+19½ᵐ) A. M., and amounts to but 14″; the Toronto hour is 8 A. M. with 6″, and from a five years' series of observation, with 31″ of deflection. The range of the disturbance variation equals 46″.[1] The disturbance amplitude, as well as the regular variation amplitude, is greater at Toronto than at Philadelphia, the occurrence of the maximum and minimum disturbance deflection seeming to be about one hour earlier at the latter station. From three in the morning till five in the afternoon the mean effect of the disturbances is to deflect the north end of the magnet to the west, and during the remaining hours (principally at night) to the east. The westerly and easterly disturbance deflections during a day balance within 0′.02.

The annual inequality in the amplitude of the diurnal disturbance variation might be satisfactorily shown by the proper combination of the results for consecutive years, comparing each two-year series successively; but owing to the small amount of the amplitude itself, and the incomplete or partly interrupted series of observations in the years 1840, 1843, and 1845, it was thought best to restrict the present discussion to the mean disturbance variation.

It is my intention to continue the discussion of the observations made at the Girard College Observatory.

After the above was written,[2] No. 1185 of the *Astronomische Nachrichten* came to hand, containing Prof. R. Wolf's interesting results on the close connection of the variation in frequency of the solar spots, and the corresponding inequality in the amplitude of the diurnal variation of the declination. He deduces for Munich the formula $\beta = 6'.273 + 0'.051\ a$ in which a is a relative number expressive of

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[1] At Toronto 51″, and from a five years' series 83″.

[2] For former communications by Prof. R. Wolf, see Nos. 839, 1043, 1091, 1132, 1160, and 1181, *ibid.*

the frequency of the solar spots directly derived from observation and β the amplitude of the diurnal variation. He finds a very close correspondence between the computed and observed values of β, and gives in a table Dr. Lamont's and his own results between the years 1835 and 1850. He also reaffirms his former value for the average length of the solar spot period., viz., 11.11 years $\pm$ 0.04 years, the limits of variation being 8 and 16 years. This period is deduced from observations of maxima and minima since 1626.

For Philadelphia we have $\beta = 7'.080 + 0'.039\ \alpha$ representing the observed amplitudes as follows:—

Year.	α (from solar spot) observations.	β derived from α.	Observed amplitude, or β.	Difference obs'd and comp'd β.	Year.	α (from solar spot) observations.	β derived from α.	Observed amplitude, or β.	Difference obs'd and comp'd β.
1840	51.8	9'.10	9'.08	—0'.02	1843	8.4	7.'41	7'.46	+0'.05
1841	29.5	8.23	8.06	—0.17	1844	12.2	7.55	7.51	—0.04
1842	19.2	7.83	7.83	0.00	1845	32.4	8.34	8.53	+0.19

The correspondence between the observed diurnal amplitude and the same derived from observations of the solar spots is further exhibited by Fig. 5, the heavy line representing the magnetic, the other the solar amplitude curve. The dotted curve is from the Toronto magnetic observations, merely multiplied by $\frac{8}{9}$ to reduce (approximately) to the Philadelphia scale. The next maximum amplitude, according to the solar spot observations, would be in 1848, amounting to 11'.00; and the whole range of the inequality in the amplitude of the diurnal motion would, therefore, be 11'.00 — 7'.46 = 3'.54. The last quantity, it must be observed, is slightly variable with each period; thus, according to the solar spot observations, the year 1837 was a maximum, amplitude 11'.41; and the year 1856 a minimum, amplitude 7'.24, the difference being 4'.17.

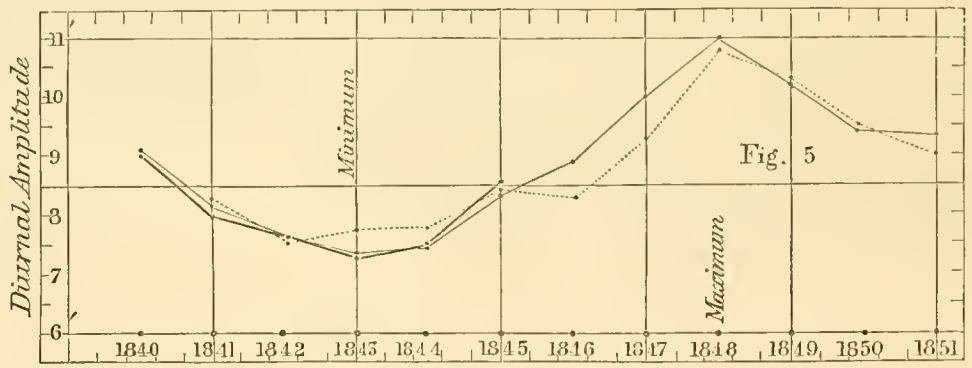

Fig. 5

It is much to be desired that this interesting branch of physical inquiry should be further studied, as it forms one of the links connecting terrestrial with cosmical phenomena.

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

METEOROLOGICAL OBSERVATIONS

IN THE

ARCTIC SEAS.

BY

ELISHA KENT KANE, M. D., U.S.N.

MADE DURING THE SECOND GRINNELL EXPEDITION IN SEARCH OF SIR JOHN FRANKLIN, IN 1853, 1854, AND 1855, AT VAN RENSSELAER HARBOR, AND OTHER POINTS ON THE WEST COAST OF GREENLAND.

REDUCED AND DISCUSSED,

BY

CHARLES A. SCHOTT,

ASSISTANT U. S. COAST SURVEY.

[ACCEPTED FOR PUBLICATION, MAY, 1858.]

COLLINS, PRINTER,
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INTRODUCTORY LETTER.

WASHINGTON, *May* 17, 1858.

PROFESSOR JOSEPH HENRY, LL.D.,

Secretary of the Smithsonian Institution:

DEAR SIR: The records of the meteorological observations made under the direction of Dr. Kane, in the second expedition to the Arctic regions, were placed in my hands by his late lamented father, Judge Kane, in December last.

Dr. Kane had selected Assistant Charles A. Schott, of the Coast Survey, for the reduction of a considerable portion of the observations made in that expedition; and I, therefore, placed these in Mr. Schott's possession for reduction and discussion. The work has been faithfully performed, and I recommend it for publication in the "Smithsonian Contributions to Knowledge." It is proper to state that the instruments were furnished in part by the Smithsonian Institution, and that the computations have been made at its expense.

Very respectfully, yours,

A. D. BACHE.

PART I.

TEMPERATURES.

RECORD AND DISCUSSION OF TEMPERATURES.

The vessel of the exploring expedition entered the winter quarters at Van Rensselaer Harbor, on the eastern trend of the coast of Greenland from Smith's Strait, on the 8th of September, 1853.[1] From the first of that month, she had not changed her position a mile, and the record and discussion of the observations for temperature will therefore commence, in the present paper, with September 1st, and be continued to January the 24th, 1855. This is the last day of entry in the original log-book in my possession. The temperatures after that date, and extending to the last of April, 1855, have been taken from Appendix No. XII. of the second volume of the narrative of the expedition.

The bay, surrounded by cliffs, is open towards the north and west, and the harbor is in latitude 78° 37′, and in longitude 70° 53′[2] west of Greenwich.

By the 28th of September, 1853, the erection of the meteorological observatory on the floe had been completed. It was a wooden structure, placed 140 yards from the ship, on the open ice-field, latticed and pierced with auger-holes on all sides, so as to allow the air to pass freely, and was firmly cemented to the ice at the base by freezing. To guard against the fine and almost impalpable drift which insinuates itself everywhere, and which would interfere with the observation of minute and sudden changes of temperature, a series of screens were placed at right angles to each other, so as to surround the inner chamber. The thermometers were suspended within the central chambers; a pane of glass permitted the light of the lanterns to reach them from a distance, and a lens and eyeglass were so fixed as to allow observing the instruments without going inside the screens. One of them—a three-feet spirit standard, by Tagliabue, of New York, graduated to 70° minus—was of sufficiently extended scale to be read, by rapid inspection, to tenths of a degree. It was not desired absolutely to neutralize the influence of the winds, but to make the exposure to them so uniform as to give comparable results for every quarter of the compass.[3]

The expedition was well supplied with thermometers. Thirty-six mercurial thermometers were received from the National Observatory at Washington, D. C. Their corrections near the freezing point were determined at the observatory, and

[1] See Narrative of the Expedition, Vol. II. p. 394.

[2] The result of a new reduction of the moon culminations.

[3] See Narrative, Vol. I. p. 117.

again by Mr. Sonntag, by means of Mr. Tagliabue's standard. Besides these, there were four maximum and four minimum thermometers, and two dozen spirit thermometers of various sizes, including two standards with a register 36 inches in length.[1] By one of these, and a mercurial standard of the same length, most of the temperatures of the air were noted.

Dr. Kane remarks:[2] "The temperature on the floes was always somewhat higher than at the island, the difference being due, as I suppose, to the heat conducted by the sea-water, which was at a temperature of +29°, the suspended instruments being affected by radiation."

This was on the 17th of January, 1854. On another page, he says:[3] "Upon the ice-floes, commencing with a surface temperature of —30°, I found, at two feet deep, a temperature of —8°, and at four feet +2°, and at eight feet +26°." This was in midwinter, on the largest floe in the open way off Cape Stafford. This subject will again be referred to.

Comparison of Thermometers.—The different readings of the instruments, particularly at temperatures below —40°, made their frequent comparison, in order to obtain corrective elements, a matter of great importance. Appendix No. XI. of the second volume of the narrative, contains a full exposition of the unreliable indications of the instruments at very low temperatures, and to this appendix the reader may be referred for further details.[4] Whether these anomalies be due to irregularities in the diameter of the tubes, or to unequal contraction of colored fluids of different specific gravity, it is admissible to suppose that the errors for a number of instruments, compared at the same temperature, may be as frequently in excess as in defect, provided they keep within a certain limit, beyond which the indications become useless. The mean reading of all thermometers compared at a certain temperature has, therefore, been taken for the true temperature, and, by comparing each result with this mean, a series of corrections has been obtained for each instrument. The same view was taken by Dr. Kane.

From the comparisons of February 5th, 6th, and 9th, 1854, I was led to suspect that some or all of the spirit thermometers, designated in the original log-book Nos. 1, 2, 3, 4, 5, were probably identical with those in the table of Appendix No. XI. in Vol. II. of the narrative, there named C, B, No. 4, A, No. 12, respectively. The numerous comparisons given in that appendix, and to which a few more have been added, made it unnecessary to use the observations from the above numbers in the first set of comparisons between the temperatures —68° and —20°. In the following table, arranged according to temperatures, S denotes the 36 inch spirit standard, upon which instrument the temperatures determined by the expedition mainly depend; $S_{(2)}$, a second similar standard; M, the 36 inch mercurial standard; the rest are alcoholic thermometers, from twelve to eighteen inches in length of scale. Fahrenheit's scale is used throughout.

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[1] The expedition was also provided with one or more ether thermometers, of which I could find no further account.

[2] See Narrative, Vol. I. p. 154.

[3] Narrative, Vol. I. p. 267.

[4] An extract from this appendix will be found at the end of this article.

COMPARISON OF THERMOMETER READINGS BETWEEN THE TEMPERATURES —68° AND —20°, MADE IN 1854.

Therm. No.	Feb. 5th.	Feb. 5th.	Feb. 4th.	Jan. 20th.	Feb. 5th.	March 14th.	Feb. 6th.	March 3d.	Feb. 6th.	March 12th.	Feb. 9th.	March 3d.	Feb. 9th.	March 3d.	March 3d.	March 16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
12	—80.0	—77.9	—78.2	—73.0	—71.0	—64.4	—57.8	—58.0	—57.3	—56.2	—58.0	—54.5	—54.0	—47.5	—46.7	—44.1
1	—75.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	—75.0	—72.7	—74.0	—66.5	—63.0	—58.7	—55.5	—53.5	—55.0	—53.0	—53.5	—53.5	—53.5	—46.1	—45.5	—43.2
2	—72.0	—69.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8	—70.5	—67.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9	—68.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—41.4
C	—64.6	—62.5	—63.0	—57.0	—54.0	...	—45.0	...	—44.0	...	—42.7	—43.0	—43.0	—40.5	—40.2	—38.8
S	—60.3	—58.3	—57.8	—54.8	—53.0	—50.2	—46.6	—45.5	—46.3	—43.8	—44.8	—45.0	—44.8	—41.2	—40.8	—39.1
$S_{(2)}$	...	...	...	...	...	...	...	...	...	...	—44.8	...	...	...	...	...
A	—57.0	—56.0	—56.2	—53.0	—50.0	—47.2	—44.5	—42.9	—44.0	—41.8	—43.0	—42.9	—42.5	—40.0	—39.7	—37.6
B	—56.4	—55.5	—56.0	—52.5	—51.0	—46.7	—43.6	—42.0	—43.0	—41.0	—42.0	—42.0	—42.0	—39.9	—39.0	—37.2
Means	—68.0	—64.9	—64.2	—59.5	—57.0	—53.4	—48.8	—48.4	—48.3	—47.2	—47.0	—46.8	—46.6	—42.5	—42.0	—40.2

Therm. No.	March 16th.	Feb. 25th.	Feb. 25th.	Feb. 26th.	Feb. 7th.	Feb. 14th.	Feb. 24th.	Feb. 18th.	Feb. 23d.	Feb. 20th.	Feb. 19th.	Feb. 12th.	Feb. 15th.	Feb. 19th.	Feb. 18th.	Feb. 17th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
12	—43.7	—46.2	—41.0	—37.7	—35.0	—35.8	—33.8	—33.2	—31.7	—27.9	—27 0	—25.7	—25.0	—23.8	—22.7	—21.7
4	—42.9	—43.3	—40.6	—37.0	—34.2	—35.4	—33.3	—32 6	—31.2	—27.5	—27.0	—25.0	—24.3	—23.5	—21.9	—21.7
2	...	...	...	...	—32.4	...	...	...	...	...	...	...	...	...	...	...
8	...	...	...	...	—32.9	...	...	...	...	...	...	...	...	...	...	...
9	—41.0	...	—38.9	—35.7	—33.0	...	—32.0	...	—30.2	...	—26 0	...	—24.0	—23.3	—21.2	—21.0
C	—38.2	...	—35.6	—32.8	—29.5	—29.8	—29.0	—28.8	—27.3	—24.4	—23.6	—22.2	—22.0	—21 0	—20.0	—19.6
S	—38.7	—36.6	—36.6	—34.0	—31.8	—31.7	—31.0	—30.2	—29.0	—26.9	—24.5	—22.6	—22.1	—21.2	—20.0	—19.4
$S_{(2)}$	...	...	...	...	...	—31.8	...	—30.2	...	...	...	—22.6	...	...	...	...
M	—38.4	—36.1	—36.3	—33.8	—31.3	—31.2	—30.4	—29.6	—28.6	—25.2	—23.9	—22.0	—21.5	—20.8	—19.5	—19.1
A	—37.7	—34.8	—35.2	—32.9	—30.2	—29.7	—29.5	—29.0	—28.0	—24.7	—24.2	—21.6	—21.6	—20.8	—19.7	—19.3
B	—37.2	—36.0	—34.8	—32.2	—29.8	—29.2	—29.0	—28.5	—27.5	—24.3	—23.5	—22.2	—22.0	—21.3	—20.2	—19.6
Means	—39.7	—38.8	—37.4	—34.5	—32.0	—31.8	—31.0	—30.5	—29.2	—25.8	—25.0	—23.0	—22.8	—22.0	—20.7	—20.2

From the preceding comparisons, the following corrections have been deduced:—

Readings of *S*.	Corrections.	Readings of *S*.	Corrections.	Readings of *S* and *M*.	Corrections to *S*.	Corrections to *M*.	Readings of *S* and *M*.	Corrections to *S*.	Corrections to *M*.
—60°	—7°.5	—50°	—3°.1	—40°	—1°.2	—1°.5	—30°	—0°.1	—0°.6
—59	—7.0	—49	—2.9	—39	—1.1	—1.3	—29	—0.1	—0.7
—58	—6.4	—48	—2.6	—38	—1.0	—1.2	—28	0.0	—0.6
—57	—5.9	—47	—2.4	—37	—0.9	—1.1	—27	0.0	—0.6
—56	—5.4	—46	—2.3	—36	—0.7	—1.0	—26	0.0	—0.6
—55	—4.8	—45	—2.1	—35	—0.6	—0.8	—25	—0.1	—0.7
—54	—4.4	—44	—2.0	—34	—0.5	—0.7	—24	—0.3	—1.0
—53	—4.0	—43	—1.7	—33	—0.3	—0.7	—23	—0.4	—1.0
—52	—3.7	—42	—1.4	—32	—0.2	—0.7	—22	—0.6	—1.0
—51	—3.4	—41	—1.3	—31	0.0	—0.6	—21	—0.7	—1.2
...	...	...	...	...	...	...	—20	—0.8	—1.2

The corrections between temperatures of —20° and —40° for the two standards are small, and hardly exceed 1° at the lower limit, but beyond this point, for the lower temperatures, a regular increase is observed in the correction to the spirit standard. The caliber of most of the spirit thermometers was tested before leaving New York, and the differences exhibited in the table of comparisons for the several instruments arise, perhaps, principally from the unequal contraction of colored and not chemically pure alcohol. At these extreme low temperatures, the fluid appears to change its condition, and the coloring matter, with a falling temperature, remains adhering to the sides of the tube.

In order to test his thermometers, Dr. Kane provided himself with chemically pure mercury, and noted the temperatures at which it became solid. The following notes have been extracted from the log:—

Nov. 25, 1853. The mercury was exposed upon the floe at the meteorological observatory, and remained liquid with the spirit standard at —42°.0.

Dec. 8, 1853. At two o'clock, the mercury exposed was found frozen at —40°.5 of the spirit standard, the mercurial standard being at —39°.8.

Dec. 14, 1853. The mercury froze around the edges of the saucer containing it; *S* at —41°.0, and *M* at —40°.0.

Jan. 16, 1854. Mercury in bulb ceased to record at —43°.5; observed frozen at —38°.0.

Jan. 29, 1854. The mercury in the standard instrument, after registering —43°.0, descended in the bulb; at another time it registered, after being frozen, —44°.0, and then became stationary.

Nov. 29, 1854. Mercury congealed at —43°.0 of spirit standard, and resumed its fluidity at —38°.0.

If we refer the readings of the spirit standard to those of the mercurial standard by adding +0°.3, we obtain the following observed temperatures for the freezing point of mercury:—

—40°.2 —39°.8 —40°.7 —40°.0 —38°.0 and —42°.7 Mean, —40°.2

Similar differences in the freezing point of mercury have been noticed by other observers; Parry, for instance, saw the mercury liquid at —43°. The above mean being so near to what is generally assumed (—40°) as the point of congelation, I thought it best to apply no correction to the readings of the mercurial standard, and to diminish that of the spirit standard, for temperatures lower than —40°, by the apparent difference, at that temperature, between the indications of the mercurial and all other thermometers compared with it, or by the constant 1°.5; thus the maximum correction to the spirit standard becomes —6°.0 at —60°.

Thus applying the proper corrections to the spirit standard *S*, according to observations of February 4, 1854, spirit of naphtha became solid at —57°, oil of sassafras at —46°, bisulphuret of carbon at —26°; oil of wintergreen clouded at —40°, and remained liquid at the maximum temperature of that day, viz: —63°; the ethers likewise remained unchanged. On the following day, aqua ammonia F. F. froze solid from two hours exposure at a temperature of —52°, chloric ether became solid, and, after four hours of exposure, chloroform was covered with a granular follicle at —66°.

Table of Corrections to Spirit Standard *S*, of Temperatures between —60° and —40°.

Scale.	Corrections.	Scale.	Corrections.	Scale.	Corrections.	Scale.	Corrections.
—60°	—6°.0	—54°	—2°.9	—49°	—1°.4	—44°	—0°.5
—59	—5.5	—53	—2.5	—48	—1.1	—43	—0.2
—58	—4.9	—52	—2.2	—47	—0.9	—42	+0.1
—57	—4.4	—51	—1.9	—46	—0.8	—41	+0.2
—56	—3.9	—50	—1.6	—45	—0.6	—40	+0.3
—55	—3.3						

Corrections to *S*, for Temperatures between —40° and —20°.

Scale.	Corrections.	Scale.	Corrections.	Scale.	Corrections.	Scale.	Corrections.
—40°	+0°.3	—34°	+0°.2	—29°	+0°.6	—24°	+0°.7
—39	+0.2	—33	+0.4	—28	+0.6	—23	+0.6
—38	+0.2	—32	+0.5	—27	+0.6	—22	+0.4
—37	+0.2	—31	+0.6	—26	+0.6	—21	+0.5
—36	+0.3	—30	+0.5	—25	+0.6	—20	+0.5
—35	+0.2						

For temperatures between —20° and +15°, the following table of corrections has been constructed. The third column contains the number of comparisons.

Scale.	Corrections.	Comparisons.	Scale.	Corrections.	Comparisons.	Scale.	Corrections.	Comparisons.
—20°	+0°.5	24	+1°	+0°.5	...	+ 7°	+0.2°	...
—15	+0.5	24	+2	+0.4	...	+10	+0.3	19
—10	+0.6	25	+3	+0.3	...	+12	+0.2	...
— 5	+0.5	17	+4	+0.2	...	+14	+0.1	...
0	+0.5	24	+5	+0.1	57	+15	0.0	6

In the absence of direct comparisons for temperatures of +16° and upwards, I have adopted Mr. Sonntag's corrections, as found by comparing the daily means for May, June, and July, in the log-book, with the corresponding means in Appendix XII. of Vol. II. of the narrative. They have, however, all been diminished by 0°.7, the correction, according to his table, applicable at +15°.0, for which temperature I have found that no correction was required. The last set of corrections to the spirit standard becomes then—

Scale.	Corrections.	Scale.	Corrections.
+15°.0	0°.0	+30°.0	—0°.7
+18.0	—0.1	+35.0	—0.5
+20.0	—0.3	+40.0	—0.4
+15.0	—0.5	+45.0	—0.4

In the following abstract of the hourly record of the atmospheric temperatures from September 1st, 1853, to January 24th, 1855, observed at Van Rensselaer Harbor, the *corrected* figures have been inserted in accordance with the previous investigation; foot notes contain any additional information that may be required.

These temperatures refer to the level of the sea. The observations were made by the officers and men on duty, and are referred to mean local time. Occasional short interpolations were effected by means of the known diurnal variation, and the gradual change in the absolute temperature; in all cases, accordingly, the means given are *corrected* for any such omission in the record. The hourly series in my possession terminates with January 24th, 1855; the daily means up to April 30th, 1855, have been extracted from the second volume of the narrative. Before these numbers were set down, the difference in the system of corrections, as adopted by Mr. Sonntag, and in the present paper was applied.

That the temperature was lower in winter in exposed positions at the astronomical observatory, and in the outer bay or channel, than at the meteorological observatory on the floe in the harbor, there can be no doubt; but, owing to non-

compared instruments, the exact amount cannot be ascertained. November 23d, 1853, on the floe outside, the temperature was 10° lower, and again, December 20th, 1853, it was 6½° lower than inside. On the 19th of January, 1854, the spirit standard on the floe inside indicated —50°, and at the astronomical observatory the temperature was —58°.

To the local difference, in winter, of the temperature of the air incumbent on land, and on ice-floes resting on a sea with a temperature not far from its freezing-point, I have already alluded. During the first winter, the temperatures were observed on the floe, but, during the second, on board the brig; the mean difference, for the five coldest months in the two years, amounts to 1°.5, and for the absolute minima it is but 0°.9—the first being the colder in either case. This result, together with the statement (p. 405, Vol. II. of the Narrative) that *local* radiations were guarded against as far as possible, leaves no doubt that the recorded temperatures during the coldest months of the first season are not sensibly affected by any local radiation; at the same time, it must be admitted that, in winter, the ice-covered sea is, nevertheless, a source of heat which, propagated through this cover, is expended by radiation into the colder atmosphere.

Occasional omissions in the hourly record have been supplied by interpolation; these values are always indicated by being inclosed between brackets. The process of interpolation will be found illustrated by an example at the end of the record.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In September, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. On deck the brig Advance and at meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+28.6	+28.6	+28.1	+28.1	+28.3	+27.6	+30.6	+20.6	+18.9	+15.6	+15.1	+13.7	+17.6	+11.8	+12.0	+ 8.5
2	30.1	28.6	27.6	28.1	28.1	27.1	31.1	19.6	19.1	15.1	15.1	13.0	15.8	11.8	13.2	9.1
3	30.1	28.6	27.6	28.1	28.1	27.1	31.1	19.6	18.9	14.6	15.1	12.3	14.6	12.3	13.7	9.4
4	29.6	28.6	28.9	28.1	27.8	27.1	31.6	19.3	18.6	14.3	14.6	12.3	13.9	12.3	13.4	9.9
5	29.6	28.6	28.6	28.3	27.6	27.6	31.1	18.1	18.6	14.1	15.1	12.3	13.7	12.3	13.2	10.4
6	29.6	28.6	28.6	28.3	27.8	27.8	30.6	18.6	19.6	19.1	15.6	14.6	14.2	12.4	13.2	10.9
7	29.6	28.3	28.6	28.3	27.6	28.1	30.8	20.1	21.1	17.1	16.1	16.6	17.8	13.2	13.0	11.8
8	29.6	28.6	28.6	28.6	27.8	28.1	31.6	19.6	22.1	21.6	16.6	20.6*	21.6	13.2	13.7	13.2
9	30.3	28.6	28.6	28.6	28.1	28.1	31.6	19.8	19.9	17.6	17.6	26.1	23.6	14.7	14.2	13.9
10	30.3	29.6	28.6	28.6	28.1	28.6	31.6	19.6	19.4	18.4	19.4	25.1	21.6	15.3	14.2	14.6
11	30.3	29.6	28.6	29.6	27.6	29.1	31.6	19.6	19.4	19.2	17.3	20.1	17.6	15.8	14.6	16.1
Noon	28.6	30.1	28.6	29.6	28.1	29.6	31.6	20.6	19.3	18.7	17.2	20.1	16.6	14.9	14.6	15.1
13	30.6	30.6	28.6	28.6	28.1	30.6	29.3	21.1	19.6	18.6	17.6	20.1	14.8	14.6	17.3	18.1
14	30.6	30.3	28.1	28.1	28.1	30.6	26.6	21.1	19.6	18.6	17.6	20.6	13.9	14.3	16.1	20.8*
15	30.6	30.3	28.1	28.6	28.1	30.6	24.6	21.1	19.1	17.6	18.1	20.6	15.6	15.1	16.4	19.6
16	30.6	30.1	27.6	28.6	28.1	29.3	25.1	21.6	19.1	17.1	17.1	19.6	14.6	15.3	16.6	15.6
17	30.1	28.1	27.6	28.6	28.1	29.8	24.3	21.6	19.6	16.6	17.1	20.6	14.2	16.1	14.6	15.1
18	29.6	27.6	28.1	28.1	27.6	28.6	23.6	21.1	18.6	16.6	17.6	19.6	14.6	16.1	13.0	15.1
19	30.1	27.6	28.6	28.3	27.6	(28.1)	23.1	21.1	19.1	16.1	17.6	19.8	13.2	14.2	12.3	15.6
20	29.6	27.6	28.6	28.3	27.6	27.6	22.1	21.1	18.6	15.6	16.6	19.9	12.2	14.2	11.5	15.6
21	29.6	27.6	28.6	28.1	27.6	28.6	21.8	20.8	18.8	15.9	16.2	19.5	12.2	13.2	10.7	15.6
22	29.1	27.6	28.6	28.1	27.1	28.6	21.6	20.4	18.5	15.8	15.1	19.3	13.7	12.6	11.1	14.6
23	29.1	27.6	27.6	28.6	27.1	29.1	21.3	19.4	17.6	15.5	13.9	18.8	12.7	12.0	10.9	13.7
Midn't	+29.1	+27.6	+27.6	+28.6	+27.1	+29.6	+20.8	+18.8	+16.3	+15.0	+13.9	+18.3	+12.7	+11.3	+10.2	+13.7
Means	+29.79	+28.71	+28.28	+28.45	+27.80	+28.62	+27.46	+20.18	+19.14	+16.85	+16.38	+18.48	+15.54	+13.71	+13.49	+14.00

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.		Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°		°
1h.	+14.6	+ 8.0	+ 6.7	+ 5.0	+ 5.2	+ 4.5	+19.6	+18.6	+18.6	+17.1	+11.8	+ 8.9	+ 9.3	+ 9.8	...	+16.38
2	14.6	8.2	6.0	4.0	5.2	4.0	17.6	17.1	17.6	15.6	11.8	9.4	9.2	9.7	...	16.08
3	12.7	7.5	6.0	3.7	5.0	4.0	17.6	17.1	17.6	13.7	11.6	9.3	9.0	9.8	...	15.86
4	11.8	6.2	5.0	3.7	4.0	4.2	18.1	16.6	16.1	12.7	11.3	8.4	8.6	9.3	...	15.54
5	11.2	6.2	4.5	4.0	3.7	5.0	18.1	18.3	17.1	8.9	10.4	9.0	7.7	4.7	...	15.27
6	11.2	6.2	5.5	5.5	6.0	5.2	18.6	19.3	19.1	9.4	11.3	8.6	8.0	5.0	...	15.95
7	11.8	8.0	7.0	7.5	8.2	11.8	18.6	19.8	19.1	9.6	11.3	8.6	7.6	4.0	...	16.70
8	15.6	12.3	7.0	11.4	10.6	13.7	18.9	19.8	19.1	16.6	11.3	8.9	7.8	3.7	...	18.06
9	(15.2)	15.6	9.0	10.9	10.1	16.6	19.6	19.6	20.6	16.6	11.8	8.6	8.2	5.1	...	18.63
10	(14.8)	17.6	10.0	11.4	14.2	19.1	19.6	18.6	21.6	19.6	13.2	9.3	8.9	6.1	...	19.23
11	(14.4)	18.6	11.0	10.9	14.6	18.6	23.1	18.6	21.6	15.6	13.2	9.8	9.1	9.3	...	19.15
Noon	(14.0)	12.7	11.0	14.1	13.7	17.3	23.6	18.8	23.6	13.2	12.7	10.3	9.3	9.5	...	18.90
13	13.7	12.7	10.5	11.1	13.7	17.8	23.1	17.1	23.3	12.2	12.3	10.5	9.8	9.3	...	18.84
14	12.7	12.3	11.7	11.1	14.6	18.1	23.1	19.6	23.3	10.0	11.8	10.5	10.0	9.0	...	18.76
15	11.8	11.3	11.1	14.8	11.8	19.1	23.8	14.9	23.3	9.6	11.2	10.6	11.0	10.7	...	18.64
16	12.7	11.3	12.0	14.6	11.6	19.1	23.1	14.6	21.8	9.6	10.4	10.4	10.0	10.3	...	18.25
17	13.0	9.9	11.1	13.7	11.4	18.6	21.6	14.1	21.6	9.4	8.5	10.3	10.1	7.2	...	17.75
18	13.2	8.0	10.4	12.7	10.9	17.6	20.6	12.7	21.6	11.8	7.5	10.2	10.1	3.3	...	17.20
19	10.4	7.2	9.9	11.4	8.9	17.6	20.6	10.9	20.8	12.3	7.0	10.2	10.2	0.8	...	16.85
20	9.9	7.0	8.4	9.4	8.0	17.4	22.6	10.9	20.6	12.3	7.0	10.0	10.0	+ 0.3	...	16.35
21	9.0	(7.0)	7.0	8.4	6.7	17.1	19.8	12.5	20.6	12.3	6.5	9.8	10.1	— 0.3	...	16.04
22	9.0	7.0	7.0	9.9	6.7	18.6	19.3	14.6	21.1	8.7	6.2	9.8	10.1	— 0.3	...	15.98
23	9.9	6 0	6.0	9.7	6.5	18.6	18.8	16.6	20.1	8.7	9.4	9.7	10.1	— 0.7	...	15.81
Midn't	+ 9.9	+ 5.5	+ 6.0	+ 5.0	+ 4.7	+19.6	+18.8	+18.3	+19.3	+12.5	+ 8.9	+ 9.0	+ 9.7	— 0.7	...	+15.57
Means	+12.38	+ 9.68	+ 8.33	+ 9.33	+ 9.00	+14.30	+20.34	+16.63	+20.38	+12.42	+10.35	+ 9.59	+ 9.33	+ 5.62	...	+17.16

[1] The observations upon the floe commence Sept. 28th. From Aug. 18th to Sept. 27th, inclusive, mercurial thermometer No. 6 was used; its scale correction, determined by two standards, is, —0°.2 and —0°.7 (at +39°), mean —0°.4. On and after Sept. 27th, the spirit standard *S* was used. A second correction has been applied, to refer the temperatures on deck to the temperatures on floe, viz: at +30° and +15° none, at +10°, +0°.3, and at +5° and 0°, +0°.4; deduced from 27 comparisons.

* Value deduced from temperature 80 feet above deck.

NOTE.—The mean temperature of the air given in Appendix No. XII. of the narrative, refers to days of nautical reckoning, commencing and ending with noon; on and after September 11, 1853, civil reckoning was adopted.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In October, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	−0.8	+1.0	+ 0.5	+14.0	+12.7	+13.9	+13.1	+12.2	+ 4.6	+3.0	−5.3	+ 5.2	+12.7	+12.2	+13.2*	+6.1
2	−1.0	+0.5	+ 1.5	+13.5	+11.8	+14.7	+13.4	+11.9	+ 6.3	+1.7	−5.5	+ 8.2	+12.4	+13.3	+12.6*	+4.9
3	+0.3	+0.3	+ 1.8	+13.2	+13.5	+14.0	+13.6	+11.6	+ 7.6	+1.5	−5.5	+10.5	+12.3	+13.3	+11.8*	+3.7
4	+2.0	0.0	+ 2.1	+13.1	+15.2	+13.4	+14.0	+11.2	+10.5	+0.3	−5.5	+12.2	+12.2	+13.2	+11.6*	+2.4
5	+2.1	+2.4	+ 1.5*	+14.8	+14.9	+13.6	+13.2	+10.3	+10.3	−0.5	−6.5	+12.2	+12.6	+13.6	+10.3	+2.2
6	+2.6	+3.2	+ 3.0	+15.5	+14.5	+13.6	+10.4	+10.3	+ 9.3	−1.5	−6.5	+12.0	+12.8	+13.7	+10.5	+2.2
7	+2.9	+5.1	+ 3 3	+15.5	+14.8	+14.3	+ 9.1	+ 9.8	+ 7.7	−0.5	−7.3	+12.0	+13.3	+14.1	+10.8	+2.0
8	+3.5	+5.1	+ 3.3	+15.5	+14.3	+14.6	+ 9.8	+10.3	+ 7.1	−0.5	−7.3	+12.4	+13.1	+14.6	+11.7	+1.5
9	+5.1	+5.0	+ 4.3	+15.9	+15.2	+15.8	+10.1	+ 9.5	+ 7.1	−0.5	−7.0	+13.8	+13.3	+14.8	+13.0*	+1.9
10	+5.1	+4.9	+ 5.2	+16.2	+15.3	+16.2	+10.3	+ 9.8	+ 6.2	−1.1	−5.5	+13.1	+13.3	+14.8	+13.2*	+1.7
11	+6.1	+4.7	+ 6.3	+16.2	+16.2	+16.8	+ 9.4	+10.2	+ 6.1	−1.5	−5.0	+12.7	+14.1	+14.8	+14.6*	+2.3
Noon	+6.1	+4.7	+ 7.7	+16.0	+17.5	+17.0	+ 8.3	+ 9.5	+ 6.2	0.0	−4.5	+12.2	+14.1	+14.6	+16.6*	+2.8
13	(+4.7)	+4.7	+ 8.9	+14.5	+15.5	+14.7	+ 7.2	+ 8.5	+ 6.2	−0.5	−2.5	+12.6	+13.6	+14.5	+14.2	+2.8
14	+3.3*	+3.8	+ 8.3	+15.3	+16.0	+14.7	+ 7.2	+ 8.6	+ 6.2	−2.5	−2.5	+(12.3)	+10.8	+14.7	+14.2	+1.5
15	+3.3*	+1.3	+ 9.1	+16.6	+12.5	+14.1	+ 8.4	+ 8.7	+ 4.7	−1.5	−2.7	+12.0	+11.3	+14.8	+13.7	+3.3
16	+3.2*	+1.5	+10.1	+18.6	+12.8	+14.1	+ 8.5	+ 8.7	+ 3.3	−3.3	−3.2	+10.3	+11.2	+14.4	+13.4	+2.9
17	+2.5*	+0.7	+10.3	+18.2	+12.1	+13.2	+10.3	+ 8.7	+ 3.3	−3.6	−2.6	+10.8	+11.9	+14.2	+14.8*	+2.4
18	+1.8	−0.5	+10.3	+17.8	+13.8	+12.4	+10.7	+ 8.2	+ 3.3	−4.5	−2.2	+11.3	+11.3	+14.1	+14.6*	+1.8
19	−0.3	−1.5	+11.7	+17.0	+13.6	+13.0	+10.7	+ 7.9	+ 2.8	−5.4	−1.1	+12.2	+11.1	+14.3	+14.6*	+1.0
20	−1.5	−1.5	+13.1	+16.0	+13.4	+13.0	+10.8	+ 7.3	+ 2.4	−5.6	−0.6	+12.4	+10.6	+14.6	+13.6*	+0.5
21	−1.7	−1.0	+11.9	+14.8	+13.4	+12.9	+10.0	+ 7.2	+ 1.8	−5.5	0.0	+13.2	+ 9.6	+14.0	+11.2	+1.0
22	−1.0	−0.4	+12.4	+15.3	+12.4	+14.2	+ 9.3	+ 7.2	+ 1.9	−5.3	0.0	+12.7	+ 9.8	+13.8	+ 9.8	+3.8
23	−0.2	−0.4	+13.3	+14.8	+13.6	+14.4	+ 8.5	+ 6.2	+ 2.1	−5.5	−1.2	+12.7	+10.8	+13.6	+ 8.7	+4.9
Midn't	+1.2	0.0	+15.3	+14.7	+13.9	+14.1	+12.0	+ 4.8	+ 3 0	−4.4	−1.1	+12.7	+11.7	+13.4	(+7.4)	+5.8
Means	+2.05	+1.82	+ 7.26	+15.54	+14.12	+14.28	+10.35	+ 9.11	+ 5.42	−1.97	−3.80	+11.74	+12.08	+14.06	+12.50	+2.73

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+5.8	− 2.4	+14.1	−0.9	− 4.7	−14.8	−20.0	−1.5	+ 8.2	+8.3	− 1.5	−16.7	−15.5	−15.5	−10.4	+1.96
2	+5.1	− 1.5	+15.8	−1.3	− 5.5	−16.5	−20.5	−1.5	+ 8.2	+7.2	− 1.5	−16.0	−16.5	−16.0	−10.9	+1.57
3	+5.1	− 0.9	+17.1	−1.4	− 6.5	−16.6	−21.6	+0.5	+ 8.3	+6.2	+ 0.5	−13.7	−17.5	−16.7	−10.9	+1.79
4	+5.1	− 0.4	+17.5	−3.1	− 6.8	−17.1	−22.4	+0.1	+ 9.3	+7.0	+ 0.5	−13.5	−17.8	−17.5	− 9.4	+1.92
5	+3.8	− 1.1	+16.3	−2.5	− 7.5	−11.0	−20.0	+0.4	+ 9.5	+6.7	− 2.0	−16.5	−18.5	−17.3	−10.8	+1.82
6	+4.2	− 2.0	+16.2	−2.5	−10.4	−18.8	−20.4	+1.8	+ 9.6	+5.3	− 2.3	−16.9	−18.3	−16.8	−11.5	+1.38
7	+4.7	− 0.1	+17.5	−3.0	−11.4	−18.7	−18.5	+1.6	+11.1	+5.6	− 5.0	−16.9	−17.5	−16.6	−12.5	+1.52
8	+4.7	− 0.5	+17.2	−3.4	− 9.4	−19.9	−18.7	+1.5	+ 9.8	+5.1	− 7.4	−16.5	−17.8	−16.4	−13.5	+1.41
9	+4.0	+ 2.7	+16.8	−3.8	− 8.7	−19.1	−12.5	+2.6	+ 9.5	+2.5	− 8.8	−16.5	−18.0	−16.2	−13.8	+1.87
10	+2.7	(+3.7)	+16.5	−5.2	− 6.0	−18.0	−15.9	+2.9	+ 9.3	+2.0	− 8.1	−15.6	−18.5	−17.0	−15.5	+1.81
11	+2.0	(+4.7)	+15.0	−6.1	− 5.5	−17.6	−14.2	+4.7	+ 9.3	+2.2	−10.6	−15.5	−18.0	−16.1	−16.0	+2.01
Noon	+1.0	(+5.7)	+15.0	−6.4	− 5.5	−18.9	−13.5	+6.6	+ 9.5	+2.4	−12.0	−16.1	−16.2	−15.6	−15.7	+2.23
13	−0.5	(+6.7)	+15.0	−7.4	− 9.2	−19.3	−12.5	+7.4	+ 8.8	+3.3	−12.0	−10.7	−17.5	−14.8	−15.0	+2.00
14	(−0.8)	+ 7.7	+16.2	−7.9	− 8.0	−19.3	−11.4	+7.7	+ 8.8	+3.3	−13.5	− 9.4	−18.1	−13.7	−14.6	+1.90
15	−1.1	+11.3	+15.0	−7.9	− 7.0	−20.0	− 8.4	+9.8	+ 8.0	+3.3	−14.5	− 9.4	−18.2	−12.5	−14.7	+2.04
16	−1.0	+11.7	+14.8	−5.0	− 9.8	−19.9	− 4.0	+8.7	+ 5.6	+0.5	−14.5	−12.8	−18.2	−11.9	−15.5	+1.78
17	0.0	+10.3	+12.4	−5.5	−10.6	−18.9	− 5.3	+9.2	+ 4.2	−0.5	−13.5	−12.8	−18.4	−11.4	−15.0	+1.66
18	−2.5	+11.2	+12.4	−4.8	−13.0	−18.2	− 5.0	+9.6	+ 4.3	−1.5	−14.5	−12.7	−18.7	−11.2	−15.7	+1.38
19	−2.0	+11.5	+11.8	−4.0	−13.0	−19.9	− 4.1	+9.4	+ 5.3	−2.5	−15.3	−14.5	−18.7	−10.5	−15.9	+1.26
20	−2.1	+12.3	+10.5	−3.8	−11.2	−19.9	− 2.7	+9.2	+ 5.3	−3.5	−16.7	−14.7	−17.8	−10.9	−15.9	+1.18
21	−0.9	+12.2	+ 8.5	−2.2	−10.0	−18.5	− 0.5	+8.7	+ 7.2	−4.9	−16.5	−15.7	−17.5	−10.9	−14.5	+1.20
22	−0.5	+12.8	+ 0.5	−1.0	−13.0	−20.6	− 0.5	+7.7	+ 7.6	−5.5	−15.6	−15.0	−17.0	−10.4	−14.0	+1.01
23	−0.5	+13.3	+ 0.2	−0.5	−11.0	−21.2	− 1.5	+7.7	+ 8.3	−6.6	−16.1	−14.7	−17.5	−10.4	−14.0	+1.02
Midn't	−1.0	+13.2	0.0	−0.5	−11.0	−20.5	− 1.5	+7.4	+ 8.5	−7.1	−16.3	−16.5	−16.0	−10.4	−14.3	+1.21
Means	+1.47	+ 5.92	+13.01	−3.75	− 8.95	−18.47	−11.48	+5.09	+ 8.06	+1.62	− 9.88	−14.55	−17.65	−14.03	−13.33	+1.62

[1] Observations by spirit standard *S*.

* Supplied from observations on deck, and referred to floe.

Oct. 25th. Astronomically, the upper limb of the sun would, by calculation, graze the horizon at noon. The sun was last seen on the 15th, on account of hills and clouds obstructing the view.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In November, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—12.7	—20.3	—21.2	—14.8	—10.9	—23.5	—20.9	—10.3	—26.2	—25.0	— 8.7	—15.6	—16.0	—22.5	—26.5	—29.0
2	13.3	20.5	21.3	14.0	9.4	22.5	20.5	10.1	24.8	27.0	8.7	16.7	16.0	22.5	27.2	29.0
3	11.5	21.0	22.0	14.3	10.5	18.0	20.7	10.8	22.0	27.0	10.0	16.7	16.5	23.5	25.0	29.4
4	11.7	21.5	21.5	14.5	10.5	18.1	20.8	10.7	23.1	21.0	9.6	16.7	17.5	24.0	26.6	28.5
5	8.7	20.0	20.4	15.2	10.3	24.0	22.4	10.3	25.0	19.8	8.4	14.7	18.2	24.7	27.2	29.0
6	8.6	20.1	20.4	17.0	10.0	23.5	21.8	10.2	26.2	26.9	7.2	10.7	19.0	25.0	27.5	29.0
7	8.7	20.2	21.0	18.2	9.8	21.5	21.0	10.4	28.0	26.5	7.0	6.5	18.0	21.6	28.1	28.6
8	9.4	20.0	19.8	17.7	10.0	20.5	21.3	12.8	27.0	26.8	7.5	5.5	18.3	21.3	27.4	28.9
9	9.2	20.2	19.5	17.2	10.1	21.4	19.0	14.6	28.7	25.5	8.6	4.2	18.2	24.2	26.6	28.0
10	9.2	20.0	20.0	18.0	10.2	19.3	16.4	17.0	27.5	28.8	10.2	4.3	18.6	24.3	26.8	27.5
11	9.2	21.0	19.8	18.2	10.5	18.5	16.0	17.0	27.0	25.5	17.0	2.0	18.8	24.4	26.9	27.9
Noon	9.3	20.3	19.8	17.6	11.1	16.0	10.0	20.6	26 8	22.0	17.4	1.8	19.5	24.8	26.5	27.6
13	9.4	19.5	19.0	17.7	11.5	14.4	10.0	21.8	26.7	22.2	19.6	4.5	18.2	24.5	27.5	29.8
14	9.9	19.5	19.3	17.5	11.9	14.0	9.7	24.0	26.0	16.5	22.5	8.7	19.1	25.0	27.0	27.2
15	10.4	20.0	19.8	16.3	13.7	14.0	9.7	19.0	27.0	16.5	23.0	11.0	19.8	24.7	27.2	25.5
16	13 0	20.6	19.4	13.7	13.9	15.8	9.7	17.0	22.5	18.3	19.0	11.5	19.5	25.8	28.0	25.6
17	15.5	20.2	18.7	13.5	13.0	15.8	9.8	18.0	21.6	7.5*	16.5	11.0	20.0	27.5	28.2	26.0
18	16.3	20.0	17.5	13.2	11.5	16.7	9.5	19.5	22.8	9.2	16.8	11.6	20.5	27.4	28.0	27.5
19	18.0	20.2	17.5	14.8	12.1	16.7	9.5	19.4	23.7	8.6	17.4	13.3	21.1	26.8	28.0	27.0
20	18.7	20.5	17.5	16.2	11.9	16.0	9.8	19.5	24.2	9.2	17.6	14.7	21.7	25.8	28.4	26.0
21	19.2	21.4	19.5	15.5	16.5	14.8	10.1	17.1	25.6	7.8	19.1	12.8	22.4	25.6	27.5	25.6
22	20.0	21.4	19.3	13.4	18.4	14.0	10.4	17.6	25.2	7.8	18.4	15.2	21.8	26.8	27.8	27.9
23	19.0	21.3	18.2	11.8	20.8	18.0	10.4	21.0	25.6	7.8	18.0	16.1	22.9	26.2	28.0	26.4
Midn't	—20.0	—21.5	—16.2	—11.2	—20.8	—20.5	—10.7	—24.2	—23.2	— 6.5	—17.2	—16.6	—23.8	—26.5	—27.9	—26.4
Means	—12.95	—20.47	—19.53	—15.48	—12.47	—18.23	—14.63	—16.37	—25.27	—18.32	—14.39	—10.93	—19.39	—24.80	—27.32	—27.64

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—28.5	—27.6	—33.0	—35.0	—26.5	—36.8	—36.5	—39.5	—38.1	—22.0	—25.0	—16.3	— 1.5	—9.0	...	—22.65
2	28.0	28.7	33.0	35.0	27.0	36.1	36.0	39.7	38.0	20.5	28.3	16.2	— 2.0	7.7	...	—22.66
3	27.6	27.6	31.5	35.0	28.5	35.2	36.2	39.5	37.5	20.0	28.5	17.1	+ 0.5	5.0	...	—22.27
4	28.0	30.5	31.0	35.0	28.5	34.9	35.0	40.0	35.7	16.8	25.5	18.2	+ 0.5	4.5	...	—21.98
5	27.5	30.5	33.2	34.0	29.6	35.5	37.5	40.6	37.1	24.1	24.0	20.0	0.0	4.8	...	—22.56
6	27.1	30.4	33.7	34.0	28.0	37.5	37.8	41.8	37.7	25.4	23.6	21.0	0.0	4.2	...	—22.84
7	27.3	31.2	33.2	34.9	29.6	36.7	37.5	40.0	37.2	26.9	23.1	20.8	+ 0.5	6.2	...	—22.65
8	28.0	31.3	32.8	34.0	29.3	37.0	36.8	40.0	34.8	26.9	20.4	19.1	+ 0.5	5.8	...	—22.33
9	27.0	32.1	32.2	33.8	30.4	36.5	36.5	38.5	32.5	27.5	21.0	17.0	+ 1.0	3.5	...	—22.09
10	26.4	32.6	33.0	31.6	30.6	36.5	36.5	39.0	32.0	29.5	21.0	16.0	+ 0.6	5.8	...	—22.27
11	27.9	32.1	33.0	31.0	31.5	36.5	37.0	38.0	30.5	29.4	21.5	14.8	— 3.0	5.0	...	—22.36
Noon	29.0	32.6	33.1	33.0	31.8	36.5	36.0	38.0	31.5	29.6	21.0	14.5	— 5.5	5.0	...	—22.27
13	30.0	31.0	34.2	33.2	33.0	36.5	37.0	39.2	31.7	28.2	20.0	14.0	— 6.3	5.0	...	—22.52
14	29.5	31.5	32.5	32.5	33.0	37.5	38.0	38.3	28.0	26.4	21.7	12.5	—10.2	3.5	...	—22.43
15	29.5	31.0	35.0	33.0	33.5	35.5	38.2	37.5	27.6	27.4	21.7	12.0	—12.5	4.0	...	—22.53
16	26.8	31.0	35.1	33.8	35.7	32.7	38.0	36.5	27.5	28.0	22.5	9.5	—14.2	4.8	...	—22.31
17	24.5	33.1	35.8	33.0	35.0	31.5	38.5	36.2	28.5	26.2	20.9	5.7	—13.5	5.0	...	—21.67
18	26.6	33.6	35.5	30.8	34.8	31.5	38.0	37.8	25.7	27.2	21.8	5.4	—13.5	5.8	...	—21.87
19	25.5	33.0	35.2	29.6	33.5	31.0	37.0	37.9	25.1	27.6	22.2	8.1	—14.5	6.0	...	—22.01
20	25.8	33.2	34.0	29.7	34.0	31.5	38.0	37.2	24.1	25.2	23.0	7.0	—17.0	7.6	...	—22.17
21	22.4	32.2	35.1	28.4	36.2	35.5	39.0	38.0	23.5	26.3	22.5	6.5	—21.5	8.5	...	—22.54
22	22.5	32.1	35.2	28.1	36.0	34.5	37.7	38.0	20.0	29.4	22.5	5.2	—23.0	8.2	...	—22.59
23	22.9	32.2	35.2	28.0	36.1	36.0	40.0	38.0	20.0	29.5	23.0	5.2	—24.0	10.5	...	—23.07
Midn't	—23.2	—32.9	—35.3	—27.0	—36.3	—36.0	—39.0	—37.5	—21.5	—29.6	—19.8	— 2.0	—17.0	—11.0	...	—22.71
Means	—26.73	—31.42	—33.78	—32.22	—32.02	—35.23	—37.40	—38.61	—30.24	—26.23	—22.69	—12.67	— 8.15	— 6.10	...	—22.39

[1] Temperatures noted by spirit standard *S*, till Nov. 2d, 4h.; after this hour, and throughout the month, the indications of the mercurial standard (*M*) are given.

* Corrected by 20°.

NOTES.—Nov. 5th. Thermometers were read at 2 o'clock P. M. without a light. Nov. 10th. At noon, the thermometers could no more be read without the use of a lantern; on the 14th inst., they were again read at 11 and 12 A. M., during bright moonlight. Nov. 22d. The darkness is now complete, being barely able to read at noonday; upper limb of sun below the horizon 7° 53′. Nov. 23d. The thermometer was 10° lower outside (or at —48°) than in the harbor; at this temperature, whiskey froze in the tent.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In December, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—16.5	—29.5	—33.5	—25.0	— 8.5	—30.5	—26.4	—39.5	—35.0	—26.0	—13.5	—30.0	—27.5	—39.0	—42.5	—39.5
2	20.5	33.4	31.5	26.5	9.5	29.5	26.0	39.5	34.0	25.5	13.5	28.5	28.7	39.5	42.5	40.4
3	23.5	35.0	31.5	26.4	13.5	27.0	26.0	39.5	34.0	24.5	15.5	29.5	29.5	39.4	43.5	42.5
4	26.6	34.6	29.7	27.3	14.0	27.0	24.0	41.0	34.5	23.5	18.5	29.6	29.5	39.5	43.5	41.5
5	29.5	28.2	29.0	26.4	15.5	23.8	32.5	41.5	34.8	22.1	21.2	26.6	27.0	38.2	41.0	40.2
6	31.0	27.3	26.5	25.0	21.0	23.4	31.0	43.2	36.0	19.6	23.1	23.9	27.5	39.0	42.5	40.5
7	32.5*	24.7	26.5	23.0	17.0	26.1	31.6	41.9	33.0	19.0	23.0	24.9	29.0	37.4	41.0	40.4
8	31.7	25.2	24.5	22.2	20.5	29.2	32.0	42.5	31.5	17.8	20.5	25.4	30.5	39.4	41.5	42.0
9	28.0	24.5	25.5	26 4	24.0	31.5	37.0	41.5	34.6	15.0	20.0	26.0	30.0	40.0	42.5	42.5
10	32.0	26.0	25.5	23.6	26.5	32.0	38.3	42.5	34.0	15.0	23.8	25.8	31.5	39.8	42.9	42.7
11	30.5	24.5	26.0	23.0	28.4	32.7	37.8	42.0	34.5	12.5	24.6	26.5	34.8	40.5	43.0	41.5
Noon	24.5	22.5	26.0	20.8	28.5	33.2	38.5	43.5	31.5	10.5	26.0	26.5	34.5	40.5	42.5	41.5
13	20.9	21.0	27.1	12.0	27.4	33.7	36.9	43.5	28.8	10.3	26.4	26.5	35.0	39.5	41.6	42.0
14	23.0	22.5	26.1	12.0	27.2	33.7	37.8	43.9	25.4	10.5	27.4	27.5	35.4	38.5	41.6	39.5
15	23.1	24.5	26.2	12.5	28.2	33.5	40.8	43.9	26.8	10.0	27.9	27.0	34.0	37.5	41.4	40.5
16	22.2	26.0	27.7	14.5	27.2	33.0	42.0	44.0	26.3	9.5	27.9	25.5	35.2	40.0	39.4	40.5
17	23.0†	25.5	29.5	18.0	32.5	33.0	38.5	44.0	24.5	10.5	30.5	25.3	37.0	42.6	39.5	34.5
18	23.0	26.0	30.5	18.5	33.5	33.5	37.1	44.0	26.5	12.2	31.0	26.3	38.0	42.0	39.5	37.5
19	26.5	25.5	31.0	19.0	33.5	33.0	39.5	44.0	24.5	12.4	29.5	28.3	39.5	41.5	40.5	41.5
20	29.5	28.5	32.5	16.5	31.5	32.5	41.0	44.0	24.0	11.0	28.5	28.6	38.5	41.8	39.0	41.0
21	23.0	26.8	31.0	10.9	32.5	32.8	39.5	39.4	20.5	10.8	31.0	29.2	36.5	40.4	39.8	40.2
22	23.5	26.8	28.5	12.1	31.0	31.5	38.0	35.8	21.5	11.2	31.0	29.5	35.5	41.3	37.5	40.9
23	27.0	26.8	27.5	11.0	30.8	30.0	38.5	36.1	21.8	13.0	29.5	28.2	37.0	41.0	37.5	41.0
Midn't	—31.0	—30.4	—26.0	— 9.5	—29.5	—26.4	—40.0	—35.0	—23.5	—13.2	—28.5	—27.8	—37.5	—41.5	—38.0	—42.2
Means	—25.69	—26.90	—28.30	—19.25	—24.65	—30.52	—35.45	—41.49	—29.23	—15.23	—24.68	—27.20	—33.30	—39.99	—41.01	—40.69

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—41.5	—39.5	—21.5	—30.0	—35.0	—34.8	—28.7	—13.5	—19.0	—26.5	—14.5	+13.0	— 0.8	—19.5	—11.5	—25.35
2	42.3	38.0	21.0	30.5	33.5	35.6	27.5	13.5	19.7	23.0	14.0	+13.0	— 0.8	19.5	10.0	—25.32
3	43.5	36.0	20.5	29.5	33.8	36.0	21.5	14.8	19.5	27.5	13.5	+13.5	— 0.8	20.5	10.0	—25.64
4	42.3	37.8	19.5	29.5	33.0	36.8	18.0	15.5	20.0	25.6	13.0	+15.8	— 0.8	21.7	9.5	—25.53
5	43.4	36.6	18.8	27.7	34.8	36.8	11.5	11.2	18.0	23.2	12.2	+16.5	+ 1.4	21.6	8.5	—24.64
6	42.5	32.8	19.8	31.6	31.0	37.5	11.9	11.4	19.4	23.2	13.9	+16.0	— 0.5	21.5	8.2	—24.83
7	42.0	31.9	17.5	34.2	31.1	38.0	11.1	10.8	20.8	22.5	14.4	+ 8.7	— 1.5	20.3	8.2	—24.73
8	37.5	29.5	17.9	35.0	32.0	37.2	16.0	11.5	22.5	22.5	13.3	+ 7.0	— 2.4	21.0	6.9	—24.99
9	39.0	28.5	16.4	31.0	32.0	37.3	14.0	11.6	23.3	21.6	12.5	+ 8.5	— 6.6	22.0	7.5	—25.28
10	39.2	27.5	16.7	32.4	31.6	37.5	12.3	12.2	22.2	21.0	12.5	+ 8.5	— 8.0	21.3	8.0	—25.67
11	39.5	25.8	16.8	33.5	31.0	37.2	12.4	12.0	23.4	21.3	12.6	+ 9.8	—12.5	20.3	8.1	—25.79
Noon	41.0	25.0	16.5	30.0	32.3	33.9	11.5	12.3	23.6	21.5	12.0	+ 9.0	—14.5	19.5	8.5	—25.29
13	40.5	25.5	18.0	35.3	34.5	33.2	9.7	12.3	28.5	20.3	12.0	+ 9.5	—16.3	17.1	6.5	—24.93
14	41.0	24.5	21.7	34.3	37.8	32.0	10.3	12.2	28.7	20.4	11.8	+11.0	—16.8	16.7	7.3	—25.05
15	42.0	26.5	23.3	36.6	37.5	35.0	12.0	12.0	29.0	20.5	11.2	+ 7.7	—16.9	15.8	7.5	—25.67
16	38.4	27.5	26.5	36.5	39.5	35.5	15.0	12.0	30.1	19.5	10.2	+ 6.5	—17.2	16.5	7.6	—26.01
17	41.0	25.5	23.6	36.2	39.9	39.0	14.8	10.2	29.0	19.2	9.1	+ 4.9	—13.6	14.2	7.5	—26.01
18	41.5	25.2	24.6	38.2	40.0	32.8	14.0	10.1	29.5	19.0	8.4	+ 4.2	—12.4	13.6	8.0	—26.20
19	41.5	25.4	28.2	40.0	39.4	36.5	12.1	10.1	29.1	19.0	7.5	+ 2.5	—15.1	13.5	8.0	—26.73
20	41.5	25.0	30.1	40.2	37.0	34.6	12.2	11.0	27.4	18.5	5.2	+ 2.0	—16.4	12.5	7.8	—26.64
21	38.7	22.8	34.0	33.6	28.6	31.0	13.0	13.0	26.0	18.5	4.6	+ 1.1	—18.0	12.6	11.0	—25.44
22	38.7	22.0	34.9	30.8	28.5	31.0	12.6	13.0	27.5	17.8	3.5	+ 1.8	—20.2	12.8	10.8	—25.09
23	38.5	23.0	35.0	32.5	35.0	30.2	12.2	13.0	26.8	16.8	5.8	+ 2.2	—18.2	10.8	9.3	—25.18
Midn't	—37.5	—22.6	—30.5	—32.8	—31.6	—29.0	—12.0	—13.0	—26.5	—16.5	— 6.4	+ 1.8	—18.8	—12.5	— 5.5	—24.95
Means	—40.60	—28.52	—23.05	—33.41	—34.18	—34.93	—14.43	—12.18	—24.56	—21.06	—10.59	+ 8.10	—10.32	—17.39	— 8.40	—25.46

[1] Temperatures noted by the mercurial standard (*M*); readings between —40°.0 and —44°.0 checked by spirit standard (*S*), or noted by the latter instrument.

* Temperature falling 21°.8 in eight hours.

† Corrected by 10°.

Dec. 20th. At 3½ P. M., the temperature at the floe was —36°.5; the party at skirts of bay obtained, for the same hour, —43°.0.

Dec. 22d. Maximum depression of the sun below the horizon, at noon and for the upper limb, 11° 7′.

Dec. 28th. First heavy gale experienced since the closure of the winter harbor; wind from the S. E. (magnetic). Rise of temperature, between 0h. and 1h., 19°.4—the most sudden change yet noted.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,
In January, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.
Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—4.5	+ 2.0	+7.0	—11.6	— 8.0	—4.5	—4.8	—12.6	—23.0	—30.0	—29.6	—36.0	—21.8	—25.0	—43.2	—38.0
2	—4.5	+ 2.0	+4.0	11.8	10.5	4.7	4.8	16.7	23.5	30.0	34.1	36.5	25.5	25.0	44.5	39.5
3	—3.5	+ 2.0	+3.8	12.5	13.5	5.5	6.0	16.6	24.5	29.2	36.2	36.5	25.7	25.1	43 8	43.2
4	—3.5	— 1.0	+3.0	13.0	14.5	6.5	7.2	17.6	26.0	30.2	37.0	36.0	23.6	24.0	44.5	44.5
5	—3.5	— 2.4	+4.1	11.1	15.7	8.8	6.4	15.5	27.0	31.9	36.0	35.2	23.5	25.0	41.9	44.5
6	—2.1	+ 3.0	+3.6	10.4	14.0	9.2	6.8	17.0	26.8	32.8	36.2	35.3	23.7	26.5	43.2	45.0
7	—2.0	+ 0.9	+3.6	10.6	13.6	9.0	8.0	16.8	29.0	33.5	37.5	33.7	23.6	29.0	41.9	45.0
8	—2.0	+ 0.9	+3.5	10.8	13.0	11.1	8.0	19.5	29.2	32.8	37.4	32.5	23.0	29.0	42.3	45.8
9	—1.5	+ 0.4	+4.7	11.7	9.5	11.0	9.0	20.6	29.7	32.2	39.5	35.7	23.4	28.8	41.9	47.3
10	—2.1	+ 1.0	+4.7	11.5	10.2	9.0	7.5	24.5	29.2	31.9	39.5	30.0	23.0	29.0	45.2	47.3
11	—1.4	+ 5.0	+4.4	11.5	10.0	8.8	9.5	23.0	28.3	33.1	38.7	28.0	23.5	30.5	45.2	48.5
Noon	—1.3	+ 9.0	+3.2	12.0	8.2	7.5	4.9	18.5	28.5	29.4	38.0	32.8	22.9	31.0	45.8	46.8
13	—0.5	+11.5	+3.2	11.0	10.5	9.7	9.8	17.8	30.2	34.5	38.5	28.6	23.0	32.8	47.3	47.9
14	0.0	+ 9.7	+2.8	11.7	7.0	9.7	8.2	17.0	29.5	34.0	38.3	28.0	25.0	34.5	45.1	48.1
15	+1.6	+ 8.0	+1.2	14.0	9.0	12.0	8.5	23.8	28.1	35.0	35.5	26.1	27.0	34.7	43.2	48.5
16	+1.2	+ 8.5	+1.8	12.0	10.5	10.5	9.8	23.5	28.8	36.0	35.4	24.8	26.8	34.5	42.4	50.4
17	+1.8	+10.1	+1.5	10.8	10.8	7 0	7.6	24.9	31.0	36.0	35.2	25.0*	29.5	36.8	39.0	50.4
18	+1.5	+ 9.5	+0.4	10.2	13.5	6.0	7.6	25.6	31.0	38.5	35.8	23.0*	27.5	36.8	35.5	51.1
19	+1.0	+ 7.2	—0.2	9.8	13.4	2.2	9.0	25.2	32.0	38.5	32.8	24.1	29.0	38.4	34.5	50.4
20	+2.0	+ 7.2	—0.2	9.6	12.8	2.6	9.0	25.5	32.0	37.5	32.4	23.1	28.5	36.4	35.5	50.4
21	+1.5	+ 7.0	0.0	9.5	13.0	4.0	7.0	26.5	28.5	36.5	36.0	22.0	25.0	41.1	34.3	45.6
22	+0.5	+ 6.8	0.0	9.5	9.0	3.8	8.2	23.5	30.0	35.0	37.0	21 5	26.5	41.1	35.5	47.9
23	+0.5	+ 6.5	0.0	9.0	8.8	5.6	8.2	23.5	34.2	34.0	37.8	21.5	26.5	41.0	36.3	49.7
Midn't	+2.0	+ 5.0	—4.5	— 9.0	— 5.5	—6.0	—8.8	—23.5	—30.5	—28.0	—37.6	—21.0	—2[illegible].5	—41.0	—36.4	—48.5
Means	—0.78	+ 4.99	+2.32	—11.03	—11.02	—7.28	—7.69	—20.80	—28.77	—33.35	—36.33	—29.04	—25.12	—32.38	—41.18	—46.85

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—48.9	—39.5	—48.1	—52.5	—44.5	—26.5	—31.9	—29.5	—38.5	—21.5	—35.5	—28.5	—45.6	—47.3	—40.5	—27.82
2	49.3	42.1	47.1	52.9	39.0	27.9	38.6	29.5	36.3	21.0	32.5	28.5	45.6	49.3	43.2	—28.66
3	49.1	44.5	48.5	53.6	39.0	25.0	35.5	32.5	33.2	21.0	32.0	27.0	43.2	50.4	44.5	—28.87
4	49.1	47.1	47.9	54.2	37.0	22.9	34.5	33.5	30.0	19.5	29.6	29.0	46.8	47.9	41.9	—28.94
5	48.1	49.8	47.9	56.2	37.5	23.5	37.5	32.0	28.0	19.0	30.0	28.5	47.3	44.5	43.9	—28.97
6	47.9	48.7	47.9	56.9	37.5	23.5	37.5	33.0	27.5	19.0	30.8	26.4	42.4	47.2	44.7	—28.82
7	43.8	49.1	51.6	58.3	37.0	24.5	40.5	30.8	32.0	19.0	31.0	29.5	43.2	47.0	40.2	—29.23
8	44.2	46.2	51.6	55.5	35.2	22.5	38.5	31.5	28.5	19.2	31.0	30.0	43.4	46.3	41.0	—28.92
9	42.5	48.5	51.2	56.6	34.5	24.5	37.2	33.7	32.0	19.5	33.8	29.2	42.0	51.6	37.2	—29.38
10	40.3	46.8	52.9	58.0	36.2	25.5	31.2	32.3	32.8	20.1	35.0	37.0	43.5	46.8	33.7	—29.24
11	38.7	46.8	54.2	54.9	38.0	31.4	31.0	28.5	33.2	20.5	36.0	38.3	43.4	39.7	31.0	—28.91
Noon	35.3	49.1	52.9	53.4	36.0	36.0	30.5	34.5	29.0	22.5	37.5	38.0	44.5	41.9	28.7	—28.55
13	34.5	46.2	51.0	50.4	37.5	38.4	36.5	36.5	26.9	24.7	35.5	40.5	45.0	46.1	31.5	—29.31
14	30.7	43.8	52.2	51.6	37.5	40.5	36.5	36.5	23.0	26.5	35.5	41.8	46.4	47.3	32.5	—29.22
15	40.5	46.2	51.8	51.6	37.7	40.6	32.0	37.5	23.0	28.5	34.0	44.5	44.5	47.4	37.0	—30.05
16	43.2	45.6	53.5	50.4	39.5	39.7	36.0	37.0	23.0	32.5	31.0	45.6	43.2	46.0	39.6	—30.31
17	45.6	44.5	51.6	45.0	39.0	40.5	30.5	36.0	23.5	33.5	29.7	46.3	46.8	36.0	40.2	—29.65
18	41.3	41.9	49.1	45.6	35.5	39.5	30.6	38.0	24.2	32.5	28.6	43.8	48.5	37.5	40.2	—29.27
19	41.9	44.5	50.4	45.3	40.3	41.0	28.0	38.7	23.0	32.5	28.0	47.3	48.5	37.0	39.9	—29.60
20	41.3	44.7	52.9	50.0	41.5	41.0	30.5	39.0	22.0	33.5	26.0	45.6	47.3	39.0	40.0	—29.70
21	39.8	45.9	52.5	45.6	35.0	41.0	28.5	37.8	21.5	33.2	28.5	45.8	45.8	43.2	40.0	—29.18
22	39.0	47.9	53.2	48.5	37.0	39.0	26.8	38.9	22.0	34.1	28.0	45.3	45.0	40.2	40 0	—29.23
23	36.8	48.5	53.5	48.5	31.0	44.6	29.5	39.4	22.0	32.6	28.2	46.5	46.8	40.5	43.2	—29.70
Midn't	—40.7	—48.4	—52.2	—47.9	—29.0	—40.0	—30.4	—39.3	—22.5	—33.6	—29.3	—46.3	—47.0	—41.2	—44.7	—29.40
Means	—42.19	—46.10	—51.07	—51.81	—37.16	—33.31	—33.34	—34.83	—27.40	—25.81	—31.54	—37.88	—45.24	—44.22	—39.14	—29.21

[1] Temperatures above —40°, noted by (*M*); lower temperatures, by (*S*). * Readings changed by 10°.

Jan. 4th. To-day at noon a distinct zone of illumination was seen to the south, clearly defining the highest hills. Upper limb of sun still 10° 25′ below the horizon. The largest print is illegible at noon.

Jan. 7th. The increased illumination of the southern horizon is distinctly visible; we cannot yet read large print. (K.) Same remark on Jan. 18th.

Jan. 19th. To-day I read the title-page of my prayer-book, by turning the type towards the illuminated sky to the southward. Upper limb depressed below the horizon at noon 7° 55′.

Jan. 22d. Spirit standard read at 12 o'clock without artificial light. At 2 P. M. dark, with a faint streak of light to the south.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In February, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—46.8	—41.0	—56.0	—46.2	—52.9	—51.3	—55.5	—24.5	—49.1	—48.5	—30.0	—34.3	—28.7	—24.5	—31.7
2	47.9	41.0	56.2	46.8	56.9	51.6	54.2	27.2	45.1	43.2	29.7	33.5	30.5	20.7	31.5
3	44.5	43.7	56.9	49.1	58.0	53.2	41.9	29.2	43.2	43.2	29.2	32.7	30.6	21.0	29.2
4	44.5	39.0	52.2	52.2	60.2	54.2	31.7	23.5	45.6	44.5	31.0	32.3	32.5	22.0	29.7
5	44.5	42.0	53.4	56.0	62.1	56.9	26.5	31.5	45.8	45.6	31.5	30.8	34.5	26.2	30.0
6	39.5	42.8	51.2	60.4	65.0	49.1	27.0	31.7	46.5	43.4	31.2	23.5	34.6	28.3	30.0
7	38.5	42.9	47.4	61.9	66.0	46.8	23.2	31.7	45.8	37.8	31.5	22.5	34.5	30.4	29.5
8	38.8	45.1	44.3	62.9	65.0	46.1	22.0	31.1	44.8	34.0	31.5	21.0	35.0	31.6	28.5
9	47.1	42.5	50.4	62.9	66.4*	44.5	25.0	30.2	45.0	22.0	31.7	22.5	33.7	32.0	22.0
10	47.1	44.7	46.8	51.6	64.5	45.8	21.3	31.7	45.6	21.0	32.2	22.5	36.0	34.2	22.0
11	43.7	45.7	45.6	61.4	64.5	45.6	21.4	31.7	46.2	21.3	33.7	22.5	36.2	34.2	21.0
Noon	39.5	46.2	47.9	61.4	55.5	47.4	20.5	33.0	46.3	21.0	33.5	22.5	35.3	31.5	20.2
13	39.3	43.5	45.4	62.9	54.2	48.5	21.2	33.0	44.5	19.3	33.2	21.9	35.0	29.7	13.5
14	39.0	45.0	44.5	59.9	52.9	49.1	22.0	33.1	42.5	20.0	33.2	20.5	34.8	29.0	13.7
15	39.5	44.1	44.5	56.9	52.2	48.7	22.5	34.5	41.7	20.0	33.0	21.2	34.0	28.5	13.5
16	40.5	48.3	45.1	54.2	49.1	45.6	22.5	36.0	41.3	22.0	32.7	20.1	34.1	29.7	13.5
17	39.5	49.1	46.3	51.6	51.7	47.8	24.0	43.5	45.8	21.5	31.5	20.7	33.5	28.5	10.0
18	39.2	44.5	46.8	48.7	53.9	49.8	21.7	44.1	47.0	21.5	29.0	22.2	32.5	27.5	10.0
19	38.4	46.8	45.6	49.4	51.6	52.9	22.0	40.3	46.5	21.6	30.8	23.3	32.5	28.0	10.0
20	35.2	46.8	47.1	45.6	50.7	54.9	25.0	42.0	45.6	22.3	29.0	25.0	33.0	29.0	10.0
21	37.0	50.7	36.8	49.1	50.8	52.9	20.8	45.6	44.7	23.8	29.6	26.5	33.0	30.5	11.0
22	42.0	49.1	37.8	51.6	50.4	51.6	21.4	50.0	46.1	26.6	32.0	27.4	29.0	32.5	11.5
23	38.7	51.6	38.8	54.2	51.2	57.7	21.9	42.4	46.8	29.5	33.5	25.9	26.0	33.6	11.5
Midn't	—38.0	—55.5	—40.8	—56.2	—51.6	—58.3	—22.4	—43.4	—47.0	—30.0	—30.8	—24.8	—25.5	—33.6	—11.0
Means	—41.20	—45.48	—46.99	—54.59	—56.36	—50.55	—26.57	—35.20	—45.35	—29.32	—31.46	—25.00	—32.71	—29.03	—19.35

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.		Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°		°
1h.	—13.2	—11.0	—22.0	—20.0	—26.8	—31.5	—22.0	—27.7	—33.8	—25.6	—37.2	—38.0	—30.6	...	—34.30
2	13.7	12.2	23.5	19.6	27.6	31.6	20.8	29.5	33.5	24.1	38.7	38.0	30.6	...	—34.26
3	14.2	13.0	25.8	19.0	25.9	30.7	21.0	30.5	33.8	25.0	39.0	38.5	32.5	...	—34.09
4	14.5	12.5	25.8	16.2	27.8	30.0	22.5	29.6	33.3	25.0	31.3	38.5	35.5	...	—33.49
5	14.5	12.5	25.8	16.0	27.5	29.2	23.0	29.5	32.4	26.0	30.1	38.2	34.6	...	—34.16
6	14.0	12.5	25.8	13.6	27.5	26.9	23.0	31.5	32.4	24.5	32.5	37.0	35.0	...	—33.59
7	13.4	15.0	24.6	17.4	23.5	26.7	23.5	32.5	32.5	23.0	32.8	35.3	38.0	...	—33.16
8	14.0	17.0	23.8	17.0	24.0	27.2	22.5	32.0	34.0	25.0	30.0	35.8	35.7	...	—32.85
9	14.8	14.4	22.0	18.6	24.0	24.5	22.0	32.0	33.5	29.4	30.5	35.2	34.7	...	—32.62
10	15.5	15.3	21.0	18.9	20.8	23.0	22.0	32.9	32.3	29.4	31.0	33.0	36.5	...	—32.09
11	14.5	14.7	18.8	20.0	24.0	25.0	22.8	34.0	32.3	29.3	33.0	31.0	33.6	...	—32.42
Noon	15.0	14.5	18.8	21.0	20.8	25.2	22.5	32.4	33.5	30.5	31.5	29.3	33.3	...	—31.79
13	15.7	15.0	18.7	16.5	22.8	25.2	22.5	33.0	36.5	29.2	32.7	31.0	32.6	...	—31.30
14	16.2	17.0	17.0	16.5	25.2	25.4	24.0	34.0	31.4	33.0	32.0	31.4	34.0	...	—31.30
15	16.2	16.7	17.3	18.5	25.3	24.0	24.6	36.0	29.6	34.7	35.2	32.1	35.7	...	—31.45
16	15.0	16.5	16.0	19.8	24.0	24.5	25.7	34.5	31.2	36.3	34.6	33.4	36.8	...	—31.54
17	15.7	15.9	17.0	20.0	25.1	24.6	25.8	32.5	28.2	35.8	34.0	34.9	36.0	...	—31.80
18	14.0	15.9	18.5	20.7	26.8	25.5	26.2	33.2	27.6	38.0	34.3	32.0	35.6	...	—31.67
19	11.7	13.6	17.6	20.8	29.5	25.6	26.4	33.0	27.0	38.8	33.0	32.6	36.2	...	—31.62
20	10.3	13.5	17.0	21.0	28.6	23.0	27.4	36.9	27.5	39.2	36.0	31.5	36.5	...	—31.77
21	11.1	14.0	19.0	24.1	28.5	21.5	27.4	37.5	29.0	40.8	37.4	31.6	37.0	...	—32.20
22	11.3	16.3	20.5	25.5	29.5	24.9	28.0	38.0	29.0	40.8	39.0	31.9	37.9	...	—33.27
23	11.5	18.0	21.4	26.3	29.5	23.7	28.0	35.0	29.5	40.5	38.0	31.5	36.5	...	—33.31
Midn't	—11.3	—20.4	—21.6	—26.9	—30.0	—24.0	—27.0	—35.2	—30.0	—38.9	—37.5	—33.5	—35.2	...	—33.59
Means	—13.80	—14.89	—20.80	—19.75	—26.04	—25.98	—24.19	—33.04	—31.41	—31.78	—34.22	—33.97	—35.03	...	—32.65

[1] Temperatures noted by *M*, down to —40°; lower temperatures by *S*′.

* Minimum temperature observed this winter.

Feb. 3d. Thermometers read at 9 o'clock without the use of a lantern.

Feb. 7th. Between the hours of 2 and 4 A. M., the temperature was elevated 22°.5. Wind from the south, and blowing a gale.

Feb. 16th. By calculation, the upper limb of the sun would graze the horizon at noon. Two days later, a mist prevented its visibility. On the 20th, at noon, his rays shine on the cliffs, on the eastern side of the bay.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In March, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—37.4	—35.2	—38.6	—41.2	—42.4	—44.7	—47.0	—48.5	—40.5	—48.1	—47.1	—45.6	—47.6	—51.0	—50.4	—27.8
2	36.0	35.2	34.8	42.3	41.9	41.3	47.5	48.2	27.0	48.8	46.8	48.3	49.8	49.9	51.6	34.0
3	37.5	35.8	33.0	42.3	42.4	40.0	46.7	47.6	26.0	49.4	48.5	48.7	51.8	51.0	51.6	34.0
4	37.5	35.5	33.4	42.0	44.6	44.5	45.6	45.6	26.5	50.6	47.9	49.1	50.4	53.3	48.3	33.5
5	38.5	36.5	33.5	45.0	44.5	44.5	45.6	46.8	28.0	50.4	47.9	49.8	49.1	54.2	41.3	33.0
6	37.0	37.5	32.5	44.5	45.6	44.5	48.5	48.5	31.1	49.4	46.9	49.1	49.8	51.8	40.5	32.5
7	36.2	38.5	32.5	46.1	46.8	45.0	49.1	46.8	32.5	49.0	46.8	48.4	49.8	51.0	38.9	31.5
8	39.5	38.5	33.0	45.6	46.8	44.5	49.1	46.8	30.5	47.9	46.8	48.4	50.4	49.1	38.4	30.5
9	41.0	36.5	34.7	45.4	45.4	41.0	46.9	39.3	30.0	47.6	46.3	47.9	51.2	47.9	32.0	30.0
10	40.7	37.1	32.7	45.6	45.8	40.6	46.2	39.5	30.5	45.6	45.9	49.1	46.0	47.4	30.5	30.0
11	36.0	35.0	33.0	43.8	44.0	41.7	45.0	42.3	32.0	44.7	43.4	46.8	43.4	43.5	30.0	30.0
Noon	36.5	36.7	34.0	45.6	43.8	44.5	45.6	43.0	28.0	42.0	44.5	43.2	42.4	44.0	30.0	30.3
13	33.0	36.3	36.5	46.2	43.2	41.5	45.2	44.3	27.3	42.5	45.6	45.0	43.7	40.8	29.8	29.2
14	31.5	37.0	37.5	45.2	44.4	45.6	39.9	45.6	29.3	41.9	44.8	39.7	42.6	41.0	28.7	28.5
15	32.2	37.4	38.2	46.8	40.5	45.8	45.6	42.5	38.3	44.5	43.5	45.6	39.7	39.3	36.3	28.0
16	30.5	37.4	37.0	44.4	45.4	46.8	47.2	42.3	41.5	46.3	45.9	48.5	43.8	46.1	39.7	30.5
17	30.5	36.5	37.5	43.8	45.6	46.2	47.2	42.5	41.5	46.2	45.8	48.7	45.6	45.6	37.5	31.0
18	30.5	37.5	38.0	45.1	46.8	46.8	47.9	42.5	42.5	46.2	46.5	48.1	46.8	47.2	37.0	32.5
19	31.5	38.0	38.5	45.6	47.9	46.8	47.3	42.0	42.6	46.8	46.8	47.4	47.9	46.8	35.5	33.5
20	33.5	38.0	39.0	46.1	48.5	46.8	45.6	42.0	44.5	46.8	47.3	46.8	48.2	47.9	34.0	35.0
21	33.5	36.0	41.6	45.0	46.2	46.2	43.8	41.8	45.8	46.2	47.3	46.8	49.5	48.5	30.5	40.0
22	33.2	37.7	42.4	44.6	46.8	45.6	43.9	41.8	47.4	47.0	46.8	48.7	50.0	49.0	30.0	42.0
23	34.7	37.4	44.1	43.8	49.1	45.8	46.2	41.0	47.6	47.3	45.3	48.7	49.8	49.1	30.0	42.0
Midn't	—35.7	—38.0	—42.4	—42.6	—48.5	—45.6	—47.9	—41.4	—47.9	—47.9	—45.7	—48.6	—49.9	—50.0	—31.6	—44.1
Means	—35.17	—36.88	—36.60	—44.53	—45.29	—44.43	—46.27	—43.86	—35.78	—46.80	—46.25	—47.38	—47.47	—47.72	—36.84	—33.06

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—45.0	—47.0	—39.7	—39.5	—22.5	—17.0	—7.0	—14.5	—28.5	—40.5	—40.3	—36.8	—43.4	—45.1	—41.5	—38.76
2	45.0	47.3	42.8	39.0	22.0	—13.0	7.8	13.3	31.0	44.5	39.5	35.5	44.5	45.6	41.9	—38.58
3	43.2	46.8	43.0	41.9	21.0	—14.0	5.5	14.3	31.5	43.9	39.5	36.6	44.5	46.3	43.4	—38.77
4	46.1	47.9	45.0	42.0	20.5	—14.5	5.3	14.6	32.2	45.1	40.8	34.2	44.6	45.8	42.1	—39.00
5	46.8	47.9	43.2	41.9	20.0	—16.1	5.3	14.4	32.7	46.2	38.0	34.0	45.1	44.8	41.9	—38.93
6	45.6	46.8	44.6	40.8	19.8	—17.1	4.9	14.6	33.2	46.0	37.2	33.5	43.9	41.0	41.0	—38.70
7	44.5	44.5	47.2	42.0	19.2	— 6.0	5.8	14.5	33.6	44.5	36.8	32.0	42.5	41.0	34.6	—37.99
8	43.2	41.9	47.0	37.3	18.0	— 6.0	7.0	14.5	34.0	43.2	34.5	31.0	42.5	40.0	39.2	—37.58
9	40.0	39.7	44.5	41.8	17.2	— 2.5	9.0	13.0	31.5	41.0	33.0	29.5	42.5	39.0	37.0	—36.27
10	41.5	39.7	44.5	39.3	19.2	— 2.0	8.0	15.8	30.0	40.5	32.0	31.0	39.0	37.0	34.0	—35.70
11	40.5	40.9	43.2	34.8	16.2	— 0.5	8.4	15.6	30.0	39.0	28.7	30.2	37.0	37.0	33.4	—34.52
Noon	40.0	38.0	40.5	33.0	16.2	— 0.7	6.5	13.5	30.5	36.4	29.5	31.5	33.0	36.5	33.2	—33.97
13	38.5	36.8	40.8	30.5	15.0	+ 2.5	7.2	14.1	32.0	37.5	28.2	31.2	33.4	35.0	33.5	—33.59
14	38.5	34.8	39.9	30.5	15.0	+ 1.5	7.0	14.5	32.5	37.5	28.0	31.5	30.8	34.3	32.0	—33.18
15	38.7	38.3	37.2	34.0	14.5	— 2.2	5.0	16.0	28.3	37.0	28.0	31.2	28.3	34.5	31.0	—33.82
16	39.5	37.7	36.0	33.5	15.0	— 2.5	5.7	16.5	31.5	37.5	28.2	31.2	31.5	32.5	30.2	—34.91
17	39.5	41.0	37.8	31.5	15.5	— 2.9	8.4	18.0	33.5	41.2	28.5	32.5	35.5	35.5	30.3	—35.59
18	39.7	41.1	37.8	29.5	17.0	— 3.4	5.8	18.8	37.8	41.5	29.6	35.0	35.3	38.1	30.5	—36.22
19	39.7	41.8	37.9	29.5	18.2	— 3.9	6.9	20.6	38.4	44.5	29.2	38.0	34.5	39.9	30.9	—36.74
20	41.9	43.4	38.4	29.5	18.4	— 4.4	9.5	22.0	38.8	44.5	31.0	40.5	39.5	43.2	31.3	—37.62
21	45.1	43.3	38.6	25.0	19.5	— 2.2	10.7	22.1	39.0	43.2	34.0	43.2	41.0	43.2	31.5	—37.75
22	45.8	42.8	39.0	25.0	19.2	— 2.0	11.8	22.6	40.0	41.9	34.5	44.1	39.5	43.2	29.8	—38.00
23	47.9	35.7	39.0	24.5	19.0	— 6.0	12.0	25.0	41.8	43.2	36.0	44.5	40.3	41.5	27.2	—38.24
Midn't	—48.6	—37.0	—39.4	—21.0	—19.0	— 7.8	—12.4	—29.0	—41.0	—41.9	—35.4	—44.5	—41.0	—41.0	—24.0	—38.41
Means	—42.70	—41.75	—41.13	—34.06	—18.21	— 5.95	— 7.62	—17.16	—33.89	—41.76	—33.35	—35.13	—38.88	—40.04	—34.39	—36.79

[1] Temperatures above —40° noted by *M*; below —40°, by *S*.

March 5th. The sun shows upon our observatory on the floe at 10 o'clock A. M. Noticed an effect on the exposed thermometers during sunshine.

March 8th. Sun sunk below the hills at half-past two P. M.

March 9th. Between the hours of one and two A. M., the temperature rose from —40°.5 to —27°.0. At close of the watch, a fresh breeze from the eastward.

March 22d. Temperature rises between six and seven A. M. 11°.1; wind S. E.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In April, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—20.0	—19.5	(—35.5)	—39.9	—12.6	—13.2	—26.0	—34.0	—20.0	—11.3	—17.4	—25.4	—11.0	+3.4	—4.6	+8.5
2	20.0	19.8	(35.8)	36.4	12.0	12.0	25.8	33.8	19.5	12.0	20.0	23.5	—12.1	+4.0	—4.3	+8.0
3	19.6	20.5	(36.4)	37.2	11.6	11.6	25.0	33.0	20.0	12.8	19.0	24.0	—12.4	+3.7	—7.2	+7.5
4	19.0	21.0	(36.3)	35.7	11.8	11.0	25.0	33.5	20.0	13.3	18.0	23.0	—12.5	+3.4	—6.5	+6.3
5	18.8	21.6	(35.6)	26.7	11.0	10.3	23.7	30.5	17.5	12.0	20.0	20.5	—12.0	+3.9	—6.0	+6.5
6	18.5	18.5	(35.2)	25.5	12.3	11.0	22.0	28.0	17.3	11.0	18.0	19.5	— 9.0	+4.0	—5.5	+6.2
7	18.0	20.2	(33.9)	19.8	11.5	9.5	22.0	23.8	16.2	10.0	17.6	18.0	— 7.5	+3.8	—5.5	+7.9
8	17.8	21.2	(32.6)	17.5	13.5	10.5	21.5	24.2	13.8	7.5	14.5	18.0	— 4.0	+3.0	—3.0	+8.5
9	17.2	21.0	(30.3)	13.5	9.0	9.0	23.8	21.0	10.3	3.8	17.0	12.0	+ 2.8	+2.8	—1.8	+7.5
10	16.5	21.0	(29.1)	13.1	8.7	10.8	25.0	20.0	8.3	5.0	14.5	10.5	+ 2.2	+3.5	—1.6	+7.5
11	15.9	20.5	(27.6)	12.5	10.0	10.0	23.0	18.0	5.0	4.3	13.0	11.0	+ 3.5	+4.5	+1.2	+7.5
Noon	15.5	20.5	(26.7)	11.5	11.6	11.0	23.0	18.0	2.3	3.2	12.5	11.5	+ 4.0	+4.8	+1.5	+7.5
13	15.2	21.5	26.9	12.0	12.0	10.5	23.0	18.0	3.0	3.0	11.5	9.7	+ 4.6	+4.2	+2.0	+7.0
14	15.0	21.0	26.5	8.6	12.6	11.0	25.0	16.8	2.5	3.2	11.5	9.0	+ 4.0	+3.7	+5.5	+7.2
15	14.7	21.2	24.0	9.0	12.5	12.2	27.0	14.0	2.8	4.0	12.0	8.7	+ 3.7	+4.0	+4.0	+8.2
16	15.5	22.3	25.8	9.8	12.5	14.3	28.0	16.5	3.0	4.5	16.0	7.0	+ 3.0	+4.1	+2.5	+8.0
17	17.5	23.0	29.0	11.0	10.7	14.5	24.8	16.5	3.5	4.5	18.0	1.5	+ 2.5	+4.0	+3.6	+6.4
18	17.5	25.0	30.4	12.6	10.5	18.0	26.0	16.6	4.6	7.5	17.0	3.0	+ 3.0	+4.2	+3.0	+6.0
19	18.8	28.0	33.0	13.7	11.2	19.5	31.2	16.5	4.8	10.0	20.0	3.4	+ 2.7	+4.0	+3.6	+1.5
20	18.5	27.0	35.3	13.2	11.0	22.2	31.9	16.2	5.5	10.0	21.5	4.3	+ 2.3	+3.0	+8.0	+0.5
21	18.8	(29.9)	38.0	13.2	10.4	24.0	33.5	18.5	9.0	12.0	22.3	5.8	+ 2.0	—0.5	+7.0	0.0
22	18.8	(31.7)	39.2	13.5	13.0	27.7	36.5	18.5	9.0	13.0	23.3	6.9	+ 1.0	—3.5	+6.9	—5.5
23	18.8	(32.8)	40.0	12.5	13.0	27.0	34.0	18.5	10.0	14.5	23.0	8.8	— 0.5	—5.8	+6.8	—5.5
Midn't	—19.0	(—34.2)	—41.7	—12.5	—13.0	—27.0	—34.2	—20.0	—11.0	—15.8	—25.3	—13.0	+ 1.0	—4.5	+6.8	—6.8
Means	—17.70	—23.45	—32.70	—17.95	—11.58	—14.91	—26.70	—21.85	— 9.95	— 8.67	—17.62	—12.33	—1.61	+2.57	+0.68	+4.85

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.		Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°		°
1h.	— 7.0	—14.3	—15.0	—16.6	— 9.0	— 4.0	—3.2	—10.0	—5.5	—4.0	—1.0	0.0	—2.3	+ 4.8	...	—12.19
2	— 7.2	—13.7	—14.3	—15.5	—13.3	— 3.2	—2.5	—10.3	—6.4	—3.8	—5.0	0.0	—2.5	+ 6.8	...	—12.20
3	— 7.1	—12.0	—13.0	—14.4	—13.0	—11.0	—3.7	—10.0	—6.3	—3.5	—8.0	—0.7	—3.0	+ 6.5	...	—12.61
4	— 6.8	—12.0	—12.7	—13.5	—11.0	—10.0	—2.3	— 8.0	—6.0	—3.3	—2.0	—1.0	—2.3	+ 5.5	...	—12.08
5	— 5.0	—11.5	—15.5	—14.1	—11.0	— 7.0	—0.5	— 9.5	—4.0	+3.3	—1.5	—7.3	—4.2	+ 6.4	...	—11.24
6	— 4.0	—10.8	—12.7	—13.4	—11.0	— 6.5	+2.4	— 8.5	—8.0	+3.2	—1.5	—5.6	—4.0	+ 4.4	...	—10.57
7	— 6.3	— 8.0	—10.2	—12.4	— 8.5	— 4.5	0.0	— 7.5	—4.0	+3.7	—1.0	—5.6	—4.2	+ 4.6	...	— 9.52
8	— 7.5	— 8.0	—10.0	— 6.6	— 9.2	— 3.0	+4.5	— 7.8	—4.0	+4.0	—1.2	—5.0	+1.8	+ 4.9	...	— 8.44
9	— 6.5	— 5.8	— 7.8	— 6.0	— 7.0	+ 3.0	+4.8	— 3.2	—4.5	+4.0	—1.5	—4.0	+3.0	+ 5.3	...	— 6.76
10	— 6.5	— 5.0	— 5.0	— 2.6	— 3.5	+ 4.8	+6.0	— 1.2	—5.0	+4.2	—1.0	—4.2	+1.0	+ 6.5	...	— 6.08
11	— 6.0	— 3.8	— 4.0	0.0	— 5.0	+ 6.0	+7.2	— 1.0	—3.0	+5.3	—0.5	—3.8	+3.0	+ 6.3	...	— 5.11
Noon	— 5.0	— 3.5	— 3.0	+ 1.7	— 3.4	+ 5.8	+4.5	— 0.2	—2.5	+7.7	0.0	+4.5	+3.0	+ 6.0	...	— 4.46
13	— 3.0	— 3.5	— 2.0	+ 1.0	— 2.0	+ 7.2	+4.5	+ 2.5	—2.5	+8.1	+0.5	+5.2	+5.0	+ 7.0	...	— 4.02
14	— 1.0	— 2.0	0.0	+ 2.5	+ 0.5	+ 7.5	+4.5	+ 2.0	0.0	+8.1	+4.4	+5.0	+4.0	+10.9	...	— 3.20
15	— 2.3	— 3.0	+ 3.0	+ 2.5	— 1.0	+ 8.4	+4.5	+ 2.4	+1.0	+8.5	+5.6	+4.2	+5.2	+11.0	...	— 3.07
16	— 2.8	— 3.5	+ 2.5	+ 4.0	— 3.0	+15.0	+4.5	+ 2.3	+1.5	+9.2	+6.0	+5.0	+5.5	+10.2	...	— 3.37
17	— 1.5	— 4.5	+ 2.0	+ 3.0	+ 0.5	+11.2	+4.0	+ 3.4	+2.0	+8.3	+7.2	+5.5	+3.5	+ 8.8	...	— 3.49
18	— 3.5	— 4.8	+ 0.1	+ 0.5	+ 3.8	+ 8.5	+3.5	+ 3.2	+2.0	+8.0	+7.0	+4.0	+2.5	+ 7.0	...	— 4.36
19	— 4.0	— 7.0	— 2.0	+ 2.5	+ 0.8	+ 7.0	+2.0	+ 1.2	+1.0	+7.7	+6.4	+4.0	+2.0	+ 4.0	...	— 5.76
20	— 5.8	— 8.7	— 5.3	— 3.0	— 1.4	+ 4.4	+0.5	0.0	—1.0	+7.1	+5.2	+3 5	+2.4	+ 3.0	...	— 6.73
21	— 8.5	— 8.5	— 5.5	— 5.0	— 2.0	+ 6.5	—2.5	— 2.3	—1.5	+6.0	+2.3	+1.0	+2.3	+ 3.0	...	— 8.05
22	—12.0	— 9.5	— 6.8	— 6.0	— 3.5	+ 5.0	—5.0	— 2.2	—1.9	+5.2	0.0	—3.0*	+2.1	+ 2.1	...	— 9.59
23	—13.5	—12.2	— 6.7	— 6.5	— 5.0	+ 4.0	—7.0	— 4.0	—2.1	0.0	—0.5	—3.0*	+2.0	+ 2.5	...	—10.33
Midn't	—14.2	—13.8	—16.7	— 8.0	— 5.8	— 0.1	—9.3	— 4.5	—2.7	0.0	—1.3	—2.3*	+2.3	+ 3.0	...	—11.45
Means	— 6.12	— 7.89	— 6.69	— 5.25	— 5.12	+ 2.29	+0.89	— 3.05	—2.64	+4.04	+0.77	—0.15	+1.17	+ 5.85	...	— 7.69

[1] Temperatures noted by mercurial standard.

* Sign — supplied.

For the interpolation on the 2d and 3d, the parameter of the diurnal variation was found 1.6 and 1.9 of the mean value from six observations before and six observations after the interval. The change in the mean temperature during the same time amounted to 5°.3.

April 12th. Sun rises at half-past 3 o'clock. On the 17th inst., the sun was up at 1 A. M.

April 19th. The sun was refracted above the horizon at midnight.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In May, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+ 2.5	+ 6.8	−5.8	−6.0	−5.0	−4.5	+ 5.6	+6.4	+ 5.1	+ 5.9	+ 5.1	+ 1.5	−7.3	+0.5	+4.2	+ 5.1
2	4.6	+ 6.0	−6.5	−6.0	−7.5	−4.0	6.4	8.0	5.3	6.4	5.7	1.8	−7.1	0.5	4.2	4.2
3	6.4	+ 5.3	−5.8	−5.5	−4.8	−3.5	7.0	10.0	5.5	6.9	7.6	0.5	−5.3	2.4	4.2	4.5
4	8.5	+ 2.4	−4.5	−5.2	−4.0	−3.4	7.6	10.6	5.7	7.2	6.4	2.4	−3.1	3.3	4.2	6.4
5	13.5	+ 3.1	−3.8	−5.1	0.0	−3.3	8.2	10.8	6.2	7.2	4.4	2.9	+3.3	3.3	6.1	8.5
6	12.8	+ 5.2	−2.4	−2.5	+1.5	−4.6	9.3	11.2	6.8	7.8	5.1	3.3	+2.9	3.5	7.0	9.8
7	14.8	+ 7.0	−2.2	−2.2	+1.5	−3.6	9.8	11.7	6.5	9.3	6.1	4.7	+2.4	3.8	8.2	10.3
8	18.4	+10.0	−1.4	−1.5	+2.3	−2.0	11.7	12.2	5.5	12.7	9.3	6.1	+1.5	3.8	10.3	10.8
9	17.1	+ 9.4	−0.5	−1.0	+2.5	+0.5	12.4	12.6	6.5	14.6	12.6	7.2	+1.5	3.8	3.3	11.7
10	19.5	+ 7.6	−0.2	0.0	+2.3	+1.2	12.2	12.9	7.3	13.3	13.2	7.8	+3.1	4.0	5.1	11.4
11	16.2	+ 6.7	+0.8	+0.2	+2.1	+1.6	12.2	14.0	7.7	11.6	14.1	7.6	+4.2	5.2	7.4	11.9
Noon	14.2	+ 6.4	+1.0	+0.7	+2.2	+2.0	10.3	15.5	8.6	9.6	14.8	8.0	+5.1	7.4	8.4	12.5
13	16.0	+ 7.2	+2.3	+2.0	+2.7	+3.1	9.8	16.2	9.8	10.8	14.1	8.4	+5.3	8.1	9.0	13.5
14	18.2	+ 7.3	+2.7	+4.5	+4.0	+2.8	10.3	16.0	10.3	10.3	13.6	9.2	+5.4	8.6	10.7	14.1
15	16.3	+ 7.0	+3.3	+4.0	+4.7	+4.1	12.5	16.5	11.7	10.9	11.5	9.7	+6.7	8.2	12.5	14.6
16	15.5	+ 6.6	+3.2	+5.2	+4.5	+3.9	14.3	17.5	11.5	10.3	11.0	10.3	+7.2	8.5	14.4	15.2
17	13.2	+ 5.3	+2.0	+5.0	+4.3	+3.7	14.1	17.1	11.3	9.9	9.3	10.5	+7.4	10.3	13.7	15.0
18	10.2	+ 4.5	0.0	+4.1	+4.5	+3.5	12.2	16.3	11.5	9.7	8.5	10.3	+7.2	11.4	13.1	14.5
19	10.0	+ 3.4	−1.2	0.0	+3.0	+3.3	12.0	15.4	11.7	9.2	7.2	7.5	+7.0	10.3	11.9	14.1
20	10.4	+ 2.1	−3.0	−1.0	+1.3	+3.3	11.7	14.1	11.3	9.0	6.5	5.1	+6.7	9.8	10.3	11.2
21	10.5	0.0	−5.5	−1.5	+0.2	+2.8	11.4	12.5	10.8	8.4	5.1	3.3	+5.4	8.9	9.4	10.3
22	10.0	− 1.0	−5.8	−3.0	0.0	+2.9	11.2	10.5	10.3	8.0	4.2	2.4	+4.3	10.1	7.6	9.7
23	10.0	− 1.5	−6.0	−3.4	−0.5	+1.9	10.5	5.6	8.2	5.7	3.8	1.7	+1.9	8.1	5.4	9.2
Midn't	+10.1	− 3.0	−6.4	−3.0	−1.0	+5.1	+ 9.6	+5.1	+ 7.2	+5.4	+3.3	+0.5	+0.5	+5.1	+4.7	+ 8.9
Means	+12.45	+ 4.74	−1.90	−0.88	−0.87	+0.70	+10.51	+12.45	+ 8.43	+9.17	+8.44	+5.53	+2.76	+6.20	+8.14	+10.72

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+13.3	+11.4	+ 5.3	+ 6.3	+ 9.8	+ 8.3	+13.6	+13.2	+19.0	+23.5	+30.4	+31.4	+24.5	+28.8	+20.2	+ 9.00
2	11.6	16.3	5.8	7.5	10.3	9.0	13.8	12.8	18.6	24.5	30.4	31.9	26.4	28.8	19.8	+ 9.34
3	9.5	17.6	7.4	8.6	10.7	10.6	13.8	15.4	18.3	24.5	30.9	31.4	26.4	31.5	17.9	+10.00
4	10.0	17.9	8.1	10.4	11.8	12.6	14.4	16.2	17.9	25.5	31.4	31.9	26 9	29.5	17.9	+10.55
5	9.8	19.3	9.6	9.8	12.2	13.9	15.5	19.0	21.0	26.0	33.0	33.2	29.3	31.9	18.6	+11.85
6	10.3	20.0	10.3	10.3	14.0	17.4	17.1	18.4	19.7	28.6	34.6	36.0	31.4	30.5	19.7	+12.74
7	10.1	19.8	10.8	13.3	14.3	17.9	18.1	17.9	21.2	27.7	35.3	38.0	34.5	30.7	20.7	+13.50
8	9.3	20.7	13.5	15.3	16.4	14.5	19.1	19.7	19.7	28.1	37.0	34.4	37.5	31.4	21.2	+14.44
9	8.9	18.4	13.2	12.6	18.1	15.8	17.1	14.4	21.9	28.3	37.6	34.5	36.6	30.9	22.6	+14.36
10	9.6	19.0	15.5	16.0	18.2	17.2	14.4	15.0	22.7	30.5	38.6	34.2	37.6	31.7	25.5	+15.05
11	9.8	13.4	18.7	13.4	17.9	18.4	15.4	17.6	23.8	32.6	36.5	34.5	37.6	34.5	29.3	+15.35
Noon	10.5	12.6	19.1	12.9	18.6	22.1	18.6	17.3	24.5	31.4	35.5	40.1	39.0	34.5	29.3	+15.89
13	9.8	11.6	20.3	13.7	19.0	22.1	20.2	17.1	24.9	32.9	35.7	34.2	35.6	36.0	28.3	+16.12
14	9.8	12.2	20.8	14.3	18.5	22.1	20.7	18.2	25.5	32.4	35.1	34.9	33.4	32.4	28.8	+16.36
15	11.5	12.4	19.7	15.0	19.4	22.7	17.4	17.9	26.4	32.6	34.5	34.8	32.4	31.7	27.6	+16.46
16	14.1	13.1	19.3	16.0	18.5	23.1	17.0	19.7	24.7	31.9	34.7	33.8	33.4	32.6	28.3	+16.75
17	12.2	12.8	17.4	16.4	17.9	22.6	18.2	20.1	24.5	30.9	32.4	34.1	32.9	29.3	27.4	+16.17
18	9.7	12.5	12.8	16.2	17.8	19.7	17.9	19.3	25.1	30.9	32.0	32.6	31.8	28.3	27.4	+15.34
19	8.2	11.8	12.2	15.5	16.9	17.4	17.4	20.2	24.7	29.9	31.8	30.9	31.4	28.3	27.9	+14.49
20	7.8	11.5	11.5	13.8	15.5	16.0	16.7	20.7	24.0	31.3	31.4	29.3	30.8	26.4	26.9	+13.63
21	7.4	9.9	10.9	13.2	14.2	15.0	16.0	20.5	23.5	32.6	32.4	29.0	29.4	24.5	26.4	+12.80
22	7.6	7.7	10.0	10.8	10.5	14.5	15.3	19.0	22.9	29.8	30.4	28.9	29.4	21.7	22.6	+11.69
23	9.9	4.7	6.6	10.3	10.3	13.4	15.5	18.6	23.3	29.7	29.3	28.1	28.4	20.7	20.7	+10.65
Midn't	+10.6	+ 4.2	+ 5.1	+ 9.8	+ 8.6	+13.4	+15.4	+18.2	+23.8	+30.9	+28.3	+27.4	+28.4	+20.7	+19.7	+10.21
Means	+10.05	+13.78	+12.66	+12.56	+14.97	+16.65	+16.61	+17.77	+22.57	+29.46	+33.30	+32.90	+31.88	+29.47	+23.94	+13.45

[1] Up to the 5th, inclusive, the temperatures noted by *M*; after the 5th, by *S*.

May 20th. The sun is now acquiring power in the middle of the day sufficient to soften the snow on the surface, and black objects lying upon it sink quite fast—a tarpaulin sinking about two inches in a day.

May 26th. The thermometer indicates a temperature above the freezing point of water, for the first time in the season.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In June, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory on floe.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+23.5	+22.8	+26.2	+25.5	+21.1	+19.5	+21.1	+21.2	+24.5	+22.9	+27.7	+22.6	+22.1	+25.0	+22.6	+25.6
2	23.0	23.9	25.9	25.5	22.1	19.2	21.2	20.7	24.6	26.4	25.5	22.6	22.1	23.9	22.6	25.6
3	23.5	25.0	26.7	24.5	19.7	18.4	22.1	26.4	24.7	26.6	25.5	22.1	21.6	24.0	23.6	25.0
4	23.5	25.5	27.4	24.5	21.8	18.8	24.0	25.5	24.8	26.6	28.3	22.1	20.7	22.8	25.5	25.0
5	23.5	28.3	(28.1)	(24.7)	22.2	24.1	24.5	25.5	25.4	25.5	26.9	22.7	24.5	26.0	26.0	28.5
6	19.9	29.3	(28.8)	(24.9)	22.4	24.3	24.7	26.0	25.6	26.3	28.7	24.7	21.6	27.4	28.0	28.3
7	19.7	31.4	(29.5)	(25.1)	22.6	24.5	24.7	26.4	26.3	27.7	26.5	26.5	24.5	30.8	29.8	28.1
8	21.6	33.0	(30.2)	(25.3)	23.2	25.5	25.0	27.3	26.5	27.4	28.7	27.5	24.5	34.7	29.5	27.4
9	24.5	34.5	30.9	25.5	22.9	26.1	24.0	27.9	27.4	31.4	27.4	23.5	25.5	28.4	27.4	29.3
10	25.1	32.6	29.3	26.4	23.0	26.4	24.0	28.3	27.9	26.0	28.4	25.5	26.4	28.6	28.3	31.4
11	25.3	31.9	27.4	26.4	23.5	25.5	24.0	29.8	30.3	31.9	28.8	25.7	27.4	28.7	27.8	31.9
Noon	25.8	30.8	28.3	26.4	23.7	25.5	25.0	34.5	29.3	35.5	28.3	25.7	28.4	29.3	27.6	35.5
13	26.4	31.0	28.8	25.9	23.8	25.5	25.0	34.5	29.4	35.4	28.3	26.0	28.8	29.4	28.8	35.5
14	26.7	30.7	29.8	26.3	25.0	25.9	28.0	32.4	32.4	33.5	27.4	26.4	28.7	30.5	29.3	34.5
15	26.9	31.0	30.3	26.6	27.1	26.4	28.4	29.3	31.4	28.3	28.4	26.4	30.2	32.5	29.3	33.4
16	27.3	31.3	30.3	26.1	27.4	27.1	27.4	27.9	27.6	28.3	26.1	27.4	28.3	31.4	30.3	34.5
17	27.3	31.3	29.3	25.5	27.5	26.4	26.9	27.9	26.9	28.3	29.6	27.4	28.4	29.3	30.9	34.5
18	27.3	30.3	27.4	25.5	26.5	25.9	26.9	28.0	26.3	28.3	28.3	28.3	28.3	29.3	30.9	35.0
19	26.9	30.8	26.9	25.5	25.5	25.5	28.3	26.4	27.4	29.3	27.4	25.5	28.3	30.3	29.3	32.4
20	26.4	30.3	27.4	24.5	25.5	28.3	26.4	25.5	25.9	28.3	27.4	24.5	26.4	29.3	30.3	33.4
21	25.8	29.8	26.9	24.5	22.6	27.4	24.5	25.5	25.9	27.4	26.4	26.4	25.4	27.4	30.3	32.9
22	25.5	29.3	26.4	24.5	22.6	27.4	22.6	24.5	24.5	27.0	25.4	23.6	25.4	29.3	30.3	31.4
23	23.5	28.3	26.4	21.6	22.6	23.5	22.6	24.5	23.6	26.5	24.5	23.6	19.7	28.4	29.3	30.3
Midn't	+21.6	+27.4	+26.0	+21.6	+21.6	+22.6	+22.6	+24.5	+23.6	+26.0	+24.5	+23.6	+22.6	+28.4	+24.5	+29.3
Means	+24.60	+29.60	+28.11	+25.12	+23.58	+24.57	+24.75	+27.10	+26.76	+28.37	+27.27	+25.01	+25.41	+28.55	+28.55	+30.78

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.		Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°		°
1h.	+31.9	+30.9	+30.3	+29.3	+29.0	+29.3	+29.3	+29.1	+31.9	+32.4	+29.1	+32.9	+34.0	+37.1	...	+27.01
2	32.1	27.9	30.8	28.9	29.8	29.3	29.3	30.8	31.4	33.4	28.3	32.8	34.2	37.4	...	+27.06
3	32.0	27.9	30.8	27.9	32.3	29.8	30.3	30.8	31.4	33.4	26.9	32.8	33.8	37.5	...	+27.23
4	35.0	30.9	30.8	26.1	29.8	28.8	30.3	30.8	31.9	33.4	28.4	32.2	34.5	37.1	...	+27.56
5	35.0	32.4	33.8	27.5	29.8	31.4	27.9	33.5	36.3	34.5	31.4	31.7	37.2	36.6	...	+28.85
6	34.9	36.0	33.6	27.5	31.1	34.2	28.6	33.6	36.5	34.6	32.9	32.9	38.0	39.6	...	+29.50
7	35.0	38.3	36.2	27.9	31.5	35.1	28.5	33.7	36.5	34.6	35.7	33.6	38.6	41.6	...	+30.36
8	34.5	40.1	37.8	31.9	32.9	35.7	29.3	34.2	38.6	40.7	39.4	34.1	39.1	42.6	...	+31.61
9	35.0	32.1	38.6	28.3	28.4	34.8	29.7	37.5	36.6	35.5	39.1	34.5	37.6	40.6	...	+30.83
10	35.0	34.4	39.6	29.3	29.3	33.4	30.3	36.5	37.0	36.6	39.4	35.0	37.6	40.1	...	+31.04
11	35.5	34.9	37.1	30.3	30.3	35.3	30.3	37.3	36.6	36.6	39.4	35.5	37.2	39.6	...	+31.41
Noon	34.5	34.4	35.5	30.3	38.1	35.3	31.9	39.6	36.6	38.6	39.1	36.3	37.1	38.6	...	+32.18
13	34.5	34.5	35.0	30.9	37.6	36.0	32.4	39.1	35.5	38.6	39.1	37.0	37.1	40.1	...	+32.33
14	33.7	35.5	35.5	30.3	35.5	32.4	32.9	38.6	35.0	38.1	(37.5)	36.0	38.1	40.1	...	+32.21
15	34.5	35.0	35.5	28.3	35.0	31.9	32.9	38.1	35.0	38.1	36.0	34.5	37.1	39.6	...	+31.91
16	35.0	34.5	35.5	28.3	34.5	32.4	34.0	37.6	34.7	36.6	35.5	34.0	37.6	39.1	...	+31.60
17	34.8	34.5	35.0	28.8	35.0	30.9	34.1	37.6	33.4	37.1	34.5	34.0	37.6	37.6	...	+31.41
18	34.5	34.8	35.0	29.8	34.5	31.4	34.0	37.0	32.9	36.6	35.5	33.6	38.1	35.5	...	+31.19
19	34.5	34.5	35.0	29.5	33.5	31.4	34.5	34.5	32.4	35.0	35.5	34.5	38.1	35.2	...	+30.79
20	35.5	34.5	33.4	29.4	33.7	31.4	34.0	34.5	32.4	35.0	35.5	34.5	38.1	35.2	...	+30.56
21	34.5	34.0	33.4	29.6	33.2	30.9	29.3	34.5	32.4	34.9	35.5	33.4	38.1	34.5	...	+29.91
22	33.4	33.4	32.4	29.7	32.4	29.3	30.3	34.3	32.2	34.7	35.5	33.4	38.3	35.5	...	+29.48
23	32.4	32.4	31.4	28.8	31.6	29.5	31.3	33.5	32.4	34.5	34.5	32.9	38.1	35.0	...	+28.57
Midn't	+32.4	+31.3	+30.3	+30.0	+31.2	+29.5	+30.3	+33.5	+32.4	+34.5	+34.0	+32.9	+37.9	+34.8	...	+28.18
Means	+34.17	+33.71	+34.26	+29.11	+32.50	+32.06	+31.09	+35.01	+34.25	+35.75	+34.90	+33.96	+37.21	+37.94	...	+30.12

[1] Temperatures noted by spirit standard *S*.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In July, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At magnetical observatory on Fern Rock Island.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+35.0	+39.1	+36.0	+42.6	+39.5	+43.0	+34.0	+36.0	+32.0	+34.0	+34.0	+34.0	+35.0	+34.0	+39.0	+(33 9)
2	35.3	40.1	35.9	42.6	40.0	42.0	34.0	36.5	31.0	32.0	34.0	35.0	37.0	37.5	38.0	(34.3)
3	34.5	41.6	37.0	43.6	40.3	40.5	34.0	36.5	31.5	35.0	34.0	35 0	37.0	35.0	37.0	(34.5)
4	34.5	41.1	36.5	44.6	40.0	40.5	34.0	35.0	34.0	36.0	34.5	38.0	37.5	35.0	37.0	(34.7)
5	36.5	45.6	36.5	46.6	39.5	40.0	35.0	36.0	34.5	33.0	34.0	36.0	36.0	35.0	38.5	+34.0
6	36.0	46.1	37.5	47.6	39.5	40.0	35.0	36.5	35.0	33.0	35.0	37.0	36.0	36.0	38.0	36.2
7	36.0	45.6	39.5	43.6	40.0	42.0	35.5	36.0	35.0	34.0	35.5	37.0	36.5	36.8	37.0	36.0
8	36.5	45.1	39.0	44.6	40.0	42.0	36.0	36.0	36.0	35.0	37.0	37.0	37.0	38.0	36.6	35.5
9	36.5	49.6	39.0	48.6	41.0	41.0	38.0	37.0	37.0	36.0	37.0	38.0	38.0	39.8	37.0	36.0
10	37.2	49.6	38.5	48.6*	41.0	43.0	39.0	37.0	37.0	37.0	37.0	38.0	38.0	44.0	36.5	36.2
11	37.6	48.4	38.5	48.1	42.0	40.0	39.0	38.0	39.0	39.0	37.5	39.0	38.0	45.0	36.0	36.7
Noon	38.3	48.4	38.0	46.6	42.0	42.0	37.0	40.0	39.0	39.0	37.5	40.0	38.0	47.0*	35.0	37.0
13	38.6	48.6	36.5	48.6	39.0	41.0	37.0	39.0	39.0	39.0	38.0	41.0	40.0	48.0*	37.0	37.0
14	40.6	38.1	39.5	44.6†	38.0	38.0	37.0	36.0	39.0	43.0	38.5	41.0	41.0	49.0*	38.0	37.0
15	41.6	39.6	37.5	42.6	39.0	41.0	36.0	38.0	40.0	40.0	37.0	41.0	42.0	48.0	37.0	36.0
16	41.6	36.0†	36.5	46.6	42.0	40.0	35.0	37.0	37.0	40.0	38.0	41.0	43.0	45.0	37.0	36.5
17	39.6	39.6	36.5	44.6	41.0	35.0	35.5	36.0	36.0	39.0	39.0	38.0	41.0	45.0	38.0	37.0
18	39.6	39.9	35.5	45.6	39.0	35.0	36.0	37.0	36.0	38.0	37.0	37.0	38.0	44.0	39.0	34.8
19	42.6	37.5	35.5	43.9	42.0	34.5	36.0	36.0	35.0	37.0	36.0	37.0	37.5	43.0	39.5	33.9
20	42.6	38.5	36.5	40.1	41.0	35.0	35.5	35.0	36.0	37.0	37.0	36.0	37.0	40.0	38.0	36.2
21	39.6	39.5‡	42.5	39.1	41.0	33.0	35.0	35.0	37.0	33.0	34.0	35.0	36.0	38.7	36.0	36.4
22	39.6	35.0	37.6§	37.6	41.0	35.0	34.0	35.0	35.0	34.0	33.0	34.0	36.0	37.5	34.2	35.8
23	41.6	35.9	38.6	39.6	42.0	34.0	33.0	34.0	34.0	34.0	32.0	34.0	35.5	37.0	33.5	36.0
Midn't	+40.6	+36.5	+39.6	+40.1	+41.0	+35.0	+34.0	+33.0	+32.0	+35.0	+32.0	+34.0	+35.0	+36.0	+33.0	+36.5
Means	+38.42	+41.87	+37.68	+44.19	+40.45	+38.86	+35.60	+36.31	+35.71	+36.33	+35.77	+37.21	+37.75	+40.59	+36.91	+35.75

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	(+37.1)	(+35.7)	(+35.9)	+34.0	+35.0	+41.0	+39.0	+43.0	+38.0	+38.0	+38.5	+35.0	+39.0	+33.0	+31.0	+36.65
2	(37.4)	(35.6)	(35.6)	35.2	36.0	40.0	40.0	43.0	39.0	37.0	38.0	36.5	37.3	33.0	30.0	+36.74
3	(37.9)	(35.4)	(35 1)	36.0	35.5	39.5	40.0	44.5	39.0	36.0	36.8	38.0	36.0	34.0	29.3	+36.77
4	(38.2)	(35.3)	(34 7)	36.7	35.5	38.3	39.5	41.0	39.0	35.0	37.0	39.0	35.0	34.9	28.0	+36.77
5	+39.0	+35.2	+33.5	40.5	35.0	38.5	40.0	41.0	37.0	35.0	38.0	40.5	35.0	35.0	29.0	+36.93
6	40.0	33.0	34.0	48.0	35.0	38.5	40.5	41.5	35.5	35.0	38.0	41.0	37.0	34.0	30.0	+37.59
7	41.0	37.0	34.0	41.0	36.0	39.5	41.0	41.0	37.0	36.0	38.0	41.5	36.0	35.5	30.0	+37.76
8	38.0	36.5	35.0	40.0	37.0	40.0	43.0	43.0	38.0	37.0	38 0	43.5	44.0	37.0	30.0	+38.43
9	38.2	37.0	35.0	40.0	36.2	40.0	47.0	46.0	39.0	39.0	39.0	45.0	44.0	37.0	30.0	+39.42
10	37.7	37.0	36.5	39.2	36.0	40.0	51.0	47.0	40.0	40.5	38.0	45.0	44.0	38.0	31.0	+39.63
11	38.0	36.5	37.0	38.7	35.5	41.0	51.0	46.0	41.0	41.5	38.0	45.0	37.0	38.0	34.0	+40.00
Noon	37.0	38.0	37.0	39.0	36.5	41.0	50.0	42.0	41.0	45.0	38.0	46.0	33.0	36.0	37.0	+40.04
13	36.0	36.0	37.0	38.5	37.0	40.0	48.0	39.0	42.0	44.0	37.0	47.0	34.0	36.0	36.0	+39.83
14	37.0	38.0	37.5	39.0	37.0	40.0	48.0	40.2	43.0	40.0	37.5	48.0	35.0	35.0	37.0	+39.69
15	35.0	39.0	40.0	40.0	37.0	39.0	49.0	41.0	41.0	39.0	38.0	46.0	34.0	38.0	37.0	+39.65
16	36.0	39.0	45.0	41.0	38.5	41.0	47.0	43.0	39.0	39.0	36.5	45.0	34.0	36.0	37.0	+39.65
17	36.0	39.0	42.0	41.0	39.0	38.0	46.0	39.0	38.0	40.0	36.5	41.0	34.2	38.0	36.0	+38.85
18	37.0	38.0	40.0	40.0	40.0	38.5	46.0	38.0	38.0	39.0	36.7	41.5	34.5	39.0	36.1	+38.51
19	37.0	38.8	39.0	39.0	39.5	38.0	44.0	39.0	38.0	38.0	36.0	40.8	34.8	41.0	35.5	+38.24
20	+36.5	37.5	37.5	39.0	40.0	37.0	42.0	39.0	37.0	38.0	35.5	40.5	34.0	38.0	35.0	+37.67
21	(36.2)	37.4	38.0	39.0	40.0	37.0	41.0	39.0	41.0	36.0	35.0	41.0	34.0	35.0	34.0	+37.24
22	(36.2)	37.5	37.0	37.0	39.0	38.2	42.0	40.0	40.5	36.0	35.7	41.5	33.0	35.0	34.0	+36.67
23	(36.1)	37.0	35.0	36.0	39.5	36.5	44.0	40.0	41.0	36.1	35.8	42.0	39.0	36.0	33.0	+36.83
Midn't	(+36.0)	+36.2	+35.0	+36.0	+39.0	+37.0	+45.0	+39.8	+40.0	+35.8	+36.0	+41.0	+37.0	+36.0	+32.0	+36 94
Means	+37.28	+36.90	+36.93	+38.91	+37.28	+39.06	+44.33	+41.58	+39.25	+38.16	+37.15	+42.14	+36.45	+36.18	+33.00	+38.19

[1] The instruments were removed from the floe to Fern Rock Island magnetic observatory on the first of the month.

* The readings of the sun and shade thermometers have evidently been exchanged in the log; the above abstract contains the correct figure.

† Original record corrected by 10°.

‡ Observations from 21 hours to the same hour (inclusive) on the following day, made on board the brig. Correction to brig thermometer from comparison with two standards at +37°, −0°.7, and −0°.4; mean adopted (for mercurial thermometer No. 9), −0°.5.

§ From 22h. July 3d to Aug. 15th, mercurial thermometer No. 15 was used, according to Mr. Sonntag's notes. Comparisons with the two standards at +36°, −0°.8, and −1°.4; adopted −1°.0. On July 4th, the column in the log is still headed spirit st. I have, therefore, applied the correction on that day accordingly. The scale of No. 15 is divided from 2 to 2 degrees; the readings are generally to the nearest half degree. July 16th. Some thermometers were broken, the tent being blown down. July 22d. First six hours supplied from dry bulb readings. July 23d. At 10 and 11 o'clock, highest temperature of the season, +51°.0.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In August, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale.[1]

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+33.0	+29.0	+35.5	+34.0	+34.3	+35.0	+32.5	+31.5	+33.0	+33.0	+32.0	+29.0	+31.0	+29.0	+32.2	+24.7
2	33.0	29.0	36.0	34.0	33.0	36.2	32.0	31.5	36.0	34.0	33.0	31.0	31.0	28.0	32.2	25.2
3	32.0	29.1	36.0	33.0	32.0	37.0	31.0	32.0	38.0	33.5	34.5	32.0	31.0	28.0	31.2	24.7
4	33.0	29 0	37.0	34.0	33.1	35.0	30.0	32.0	41.0	33.0	35.0	31.0	31.0	28.0	32.2	26.2
5	33.5	31.0	35.0	36.0	34.0	33.0	33.0	32.0	35.0	33.0	34.0	29.0	30.5	28.0	30.7	28.2
6	34.0	34 0	33.0	37.0	37.0	34.1	35.0	33.0	36.0	34.0	33.0	29.0	30.0	29.0	31.2	30.2
7	37.0	35.0	32.0	38.0	35.0	34.8	37.0	33.0	36.0	35.0	33.0	29.0	31.0	30.0	31.2	32.2
8	41.0	36.0	32.0	39.0	35.0	34.7	43.0	39.0	37.0	35.0	32.0	30.0	31.0	31.0	31.7	36.2
9	45.0	38.0	34.0	40.0	37.0	34.7	41.0	40.0	38.0	36.0	33.0	32.0	31.0	30.0	31.7	35.2
10	49.0	39.0	35.0	39.5	36.0	35.5	44.0	41.0	39.0	37.0	37.0	33.0	31.0	34.0	32.2	36.2
11	42.0	41.0	35.0	39.0	37.0	36.1	36.0	41.0	40.0	37.5	42.0	32.0	31.0	34.0	33.2	37.2
Noon	41.0	43.0	35.2	39.0	37.0	36.5	33.0	40.0	41.0	39.0	38.0	31.0	31.0	33.0	34.2	38·2
13	37.0	40.0	37.0	38.5	39.0	37.0	35.0	41.0	39.0	40.0	38.0	31.0	31.0	34.0	33.2	37.2
14	36.0	39.0	35.0	38.5	40.0	37.0	35.0	42.0	38.0	41.0	37.0	33.0	31.0	36.0	35.2	37.2
15	37.0	40.0	31.0	39.0	39.0	39.0	36.0	41.0	37.0	40.0	37.0	33.0	31.0	33.0	35.2	37.7
16	37.5	37.0	33.0	39.0	39.5	35.0	35.0	41.0	37.0	39.0	36.0	33.0	31.0	32.0	33.2	37.2
17	36.0	35.0	35.0	39.0	37.0	35.0	33.0	40.0	37.0	38.3	37.0	32.0	31.0	31.0	34.2	37.2
18	35.0	34.0	35.0	38.5	37.0	34.8	34.0	39.0	36.0	38.0	38.0	32.0	31.0	31.5	34.2	38.2
19	37.0	38.0	34.7	38.0	36.5	35.0	35.0	36.0	35.5	37.0	38.0	32.0	31.0	32.0	33.2	33.2
20	35.0	37.0	34.5	35.0	36.0	35.0	35.0	33.0	34.0	36.0	39.0	32.0	31.0	32.0	33.2	41.2
21	35.0	36.5	32.0	33.0	36.0	35.0	35.0	34.0	35.0	38.0	37.0	32.0	31.0	32.5	32.2	35.2
22	31.7	34.8	33.0	34.0	36.0	34.0	35.0	34.0	34.0	38.0	36.0	31.0	31.0	32.0	31.2	28.2
23	30.5	33.0	34.0	34.5	37.0	34.0	32.0	34.0	33.0	39.0	35.0	30.5	31.0	31.5	30.2	28.2
Midn't	+28.2	+32.5	+35.0	+34.0	+39.0	+33.0	+33.0	+34.0	+33.0	+36.0	+34.0	+30.5	+31.0	+32.0	+29.2	+28.2
Means	+36.22	+35.41	+34.37	+36.81	+36.35	+35.27	+35.02	+36.46	+36.60	+36.68	+35.77	+31.25	+30.94	+31.31	+32.43	+33.05

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	
1h.	+29.7	+28.2	+27.2	+33.7	+28.2	+25.2	+19.2	+19.2	+23.7	+26.2	(+28.2)	(+23.8)	+23.2	+31.2	+30.2	+29.22
2	30.2	28.2	28.2	31.7	28.2	25.2	19.2	19.2	24.2	26.2	(28.1)	(24.2)	27.2	31.2	29.2	29.53
3	30.8	29.2	28.2	31 7	28.2	21.2	20.2	19.2	24.2	26.2	(27.9)	(23.9)	27.2	31.7	28.2	29.45
4	31.2	32.2	29.2	32.2	28.2	22.7	20.2	19.2	25.2	26.2	(27.6)	(24.1)	27.2	31.2	27.7	29.83
5	27.2	30.2	28.2	33.2	29.2	21.2	22.2	19.2	27.2	27.2	+27.2	(23.6)	29.2	31.2	28.2	29.69
6	29.2	29.2	26.2	34.2	29.2	23.2	23.2	20.2	28.2	26.2	26.7	(24.8)	30.2	30.2	29.2	30.31
7	29.2	30.2	29.2	33.2	30.2	25.2	23.2	22.2	28.7	27.2	26.2	(25.9)	30.2	29.2	30.2	30.95
8	30.2	30.2	28.2	32.2	31.2	27.2	23.2	25.2	29.7	27.2	26.2	(28.3)	30.2	28.2	29.2	31.94
9	30.2	31.2	28.2	32.2	31.2	30.2	23.2	33.2	30.7	27.2	28.2	+31.2	30.2	29.2	31.2	33.04
10	30.2	32.2	29.2	31.7	30.7	31.2	23.2	32.2	31.2	26.7	29.2	33.2	30.7	29.4	31.2	33.89
11	30.5	33.2	30.2	32.2	30.7	32.2	25.2	31.2	31.2	26.2	30.2	34.2	31.7	30.2	32.2	34.04
Noon	33.2	33.7	33.2	34.2	29.2	32.2	28.2	31.2	31.2	26.2	31.2	31.2	31.7	31.2	32.2	34.20
13	32.2	35.2	34.2	33.2	28.2	31.2	28.2	32.2	31.7	30.4	32.7	29.2	32.2	(30.0)	32.7	34.24
14	32.2	35.2	33.2	33.2	29.2	30.2	27.2	32.2	31.7	31.2	30.2	28.2	34.2	(29.9)	32.7	34.25
15	34.2	35.2	33.7	32.2	26.2	29.2	26.2	30.2	31.2	30.7	29.2	29.2	33.2	(29.8)	32.7	33.84
16	33.2	35.2	33.7	31.2	27.2	28.2	26.2	28.2	30.7	31.2	29.2	30.2	33.2	(29.3)	30.0*	33.30
17	32.2	35.2	34.2	30.7	28.2	26.2	(24.1)	31.2	29.2	31.7	30.2	29.2	34.2	(29.2)	30.0*	33.01
18	31.2	34.2	33.2	30.2	29.2	25.2	23.2	31.2	29.2	30.2	29.2	29.7	32.2	(28.9)	(24.4)	32.50
19	30.2	34.0	33.2	29.2	28.2	25.2	22.7	31.2	28.2	30.2	29.2	29.2	31.2	(28.9)	(22.5)	32.11
20	30.2	33.2	33.2	28.2	29.2	24.2	23.2	30.2	27.2	(29.9)	27.2	29.2	30.7	(28.9)	(20.8)	31.75
21	29.7	32.2	33.7	27.7	29.2	25.2	22.2	30.2	28.2	(29.6)	26.2	31.2	29.2	29.0*	22.2	31.45
22	29.7	32.2	32.2	27.7	29.2	24.2	22.2	30.2	28.2	(29.2)	25.2	31.2	29.2	29.0*	21.2	30.80
23	30.2	31.7	33.2	28.2	28.2	23.2	21.7	27.2	27.2	(29.0)	25.2	31.2	29.2	29.0*	21.2	30.42
Midn't	+30.2	+29.2	+32.2	+27.4	+27.2	+23.2	+20.2	+24.2	+26.2	(+28.6)	+25.2	+30.2	+29.2	+29.0*	+20.2	+29.84
Means	+30.72	+32.11	+31.05	+31.31	+28.91	+26.35	+23.24	+27.08	+28.51	+28.37	+28.16	+28.60	+30.28	+29.79	+27.90	+31.82

[1] According to entries by Mr. Sonntag on Aug. 15th, and by Dr. Kane on Oct. 11th, mercurial thermometer No. 12 seems to have been used as shade thermometer between these dates. Its scale is divided from 2 to 2 degrees. Correction by two standards, —1°.1 and 0°.4; mean adopted, —0°.8. Mr. Sonntag applied the same correction in the tables, p. 420 of the narrative, vol. ii., after Sept. 1st.

* Supplied from the dry bulb readings.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In September, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. On deck of the brig Advance.

Hour	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+21.2	(+18 0)	+16.2	+ 7.2	+ 3.2	+ 7.7	+10.2	+ 8.2	+ 7.2	+ 9.2	+ 9.2	+ 1.5	—3.8	+ 0.2	+11.2	+ 3.2
2	19.2	(16.5)	15.7	8.8	6.2	8.2	8.2	7.7	6.2	9.7	8.2	+ 0.7	—2.8	2.2	+11.2	3.7
3	18.2	+15.2	15.2	8.2	4.2	8.2	7.2	8.7	9.2	9.7	7.2	+ 0.2	—2.8	3.2	+11.2	3.2
4	17.2	17.2	15.2	8.2	4.2	8.2	7.2	8.7	9.2	9.7	4.2	— 0.8	—1.8	3.7	+11.2	5.2
5	17.2	19.2	15.2	10.2	6.2	9.2	8.2	9.2	11.2	10.2	5.2	+ 2.2	—2.8	4.2	+12.2	7.2
6	17.7	19.2	15.2	13.2	8.2	10.2	8.2	9.2	12.2	10.2	5.2	+ 3.2	—4.8	6.2	+11.2	7.2
7	17.2	20.2	16.2	13.2	8.5	14.2	9.2	12.2	14.7	12.2	8.2	+ 5.2	+1.2	8.2	(+11.5)	7.2
8	21.2	20.2	18.2	16.2	8.7	17.2	8.7	13.2	13.7	15.2	15.2	+ 9.2	+6.2	8.2	(+11.8)	9.2
9	21.2	21.2	17.2	17.2	10.2	18.2	9.2	15.2	14.2	21.2	17.2	+10.2	+9.2	9.2	+12.2	12.2
10	23.2	21.2	17.2	17.2	11.2	19.2	9.2	16.2	15.2	21.2	17.2	+12.2	+9.7	11.2	+12.2	13.2
11	27.2	22.2	17.2	18.2	15.2	21.2	12.2	17.2	16.2	22.2	18.2	+12.2	+8.7	14.2	+14.2	12.2
Noon	22.2	24.2	19.2	24.2	16.2	22.2	15.2	15.2	19.2	22.2	19.2	+12.2	+9.2	13.2	+15.2	11.2
13	27.2	24.2	17.2	26.2	17.2	21.2	17.2	13.2	18.2	21.2	19.2	+11.2	+9.2	12.2	+16 2	11.2
14	26.2	23.2	18.2	27.2	15.2	20.2	16.2	13.2	19.2	21.2	16.2	+11.2	+6.2	13.2	+16.2	12.2
15	26.2	22.2	17.7	25.2	12.2	19.7	14.2	13.7	18.2	20.2	14.7	+ 9.2	+6.2	13.2	+16.2	12.2
16	25.2	22.2	17.2	24.2	11.2	17.2	13.2	12.2	17.2	18.2	15.2	+ 8.2	+7.2	12.2	+15.2	11.2
17	25.2	21.2	17.2	23.2	10.2	17.2	(12.6)	12.2	17.2	17.2	11.2	+ 7.2	+9.2	11.2	+12.2	12.2
18	25.2	21.2	17.2	20.2	10.2	15.2	(12.0)	11.2	17.2	13.2	7.7	+ 4.2	+8.2	11.2	+ 9.2	11.2
19	21.2	20.2	16.2	19.2	10.2	14.2	(11.4)	11.2	17.2	11.2	6.7	+ 3.2	+7.2	11.2	+ 7.2	10.2
20	21.2	19.2	13.2	17.2	9.7	11.2	(10 8)	11.2	16.2	9.2	5.2	+ 3.7	+8.2	11.2	+ 5.2	9.2
21	20.2	20.2	13.2	9.2	9.2	11.2	10.2	11.4	15.2	8.2	5.2	— 0.3	+8.7	12.2	— 0.8	8.2
22	19.2	17.2	9.2	6.2	8.7	11.2	9.2	10.2	15.2	6.2	3.2	— 0 8	+8.2	12.2	— 2.8	7.2
23	19.2	17.2	8.2	4.2	8.2	10.2	7.2	8.2	10.7	7.2	2.2	— 1.8	+7.7	12.2	+ 1.2	4.7
Midn't	+19.2	+16 2	+ 8.2	+ 5.2	+ 5.2	+10.2	+ 8.2	+ 8.2	+10.7	+ 7.7	+ 2.2	— 2.8	+3.2	+11.7	+ 2.2	+ 4.7
Means	+21.60	+19.95	+15.45	+15.39	+ 9.57	+14.28	+10.64	+11.54	+14.20	+13.91	+10.14	+ 5.02	+4.78	+ 9.49	+10.11	+ 8.72

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.		Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°		°
1h.	+ 2.2	+1.2	+1.2	—6.8	+4.7	+ 2.2	—3.3	— 0.8	+15.2	+12.2	+13.2	+ 4.2	+ 7.2	— 0.3	...	+ 6.07
2	+ 4.2	+2.2	+2.2	—6.8	4.2	+ 4.2	—2.3	— 2.8	14.2	15.2	12.2	10.2	6.2	+ 0.2	...	+ 6.43
3	+ 4.2	+8.2	+2.2	—5.8	3.2	+ 3.2	—1.8	+ 0.2	14.2	17.2	11.2	10.2	6.2	17.2	...	+ 7.20
4	+ 3.2	+9.2	+1.2	—5.8	3.2	+ 3.2	—2.8	+ 4.2	14.2	15.2	12.2	11.2	7.2	17.2	...	+ 7.32
5	+ 3.2	+8.2	+0.7	—7.3	2.2	+ 1.2	—0.8	+ 1.2	13.2	15.2	11.2	11.2	7.2	16.2	...	+ 7.57
6	+ 5.2	+7.2	+1.2	—8.8	3.2	+ 3.0	+1.2	+ 3.2	15.2	13.2	11.2	13.2	7.2	15.2	...	+ 8.08
7	+11.2	+6.2	—0.8	—4.8	2.2	+ 3.0	+1.2	+ 7.2	15.2	13.2	11.2	11.2	8.7	15.2	...	+ 9.31
8	+13.2	+9.2	+3.2	—1.8	1.7	+ 7.0	+0.2	+ 7.2	14.2	14.2	9.2	10.2	9.2	14.2	...	+10.78
9	+11.2	+6.2	+5.2	—1.8	2.2	+ 9.2	— 0.8	+ 7.2	11.2	15.2	12.2	11.2	11.2	15.2	...	+11.67
10	+13.2	+3.2	+7.2	—0.8	3.2	+11.2	—2.8	+ 9.2	13.2	15.2	13.2	11.2	11.2	17.2	...	+12.38
11	+13.2	(+3.8)	+7.2	+0.2	1.2	+13.2	—2.8	+ 9.7	13.2	16.2	12.2	12.2	11.2	16.2	...	+13.19
Noon	+13.2	(+4.4)	+9.2	(+1.2)	9.2	+11.2	—1.8	+11.2	13.2	16.2	10.2	13.2	10.2	16.2	...	+13.91
13	+14.2	(+5.0)	+7.2	(+2.2)	5.2	+12.2	+0.2	+11.2	14.2	16.2	9.2	13.2	13.2	16.2	...	+14.06
14	+11.2	(+5.6)	+6.2	(+3.2)	7.2	+10.2	—4.8	+11.2	13.2	15.2	8.2	11.2	12.2	16.2	...	+13.38
15	+ 7.2	+6.2	+2.2	+4.2	4.2	+ 7.2	—3.8	+12.2	13.2	15.2	7.2	10.2	12.7	16.2	...	+12.52
16	+ 7.2	+4.2	+1.2	+3.7	5.2	+ 4.2	—4.8	+11.2	12.2	15.2	6.2	11.2	13.2	16.2	...	+11.78
17	+ 6.2	—2.3	—0.8	+3.2	7.2	+ 2.2	—3.8	+11.2	11.2	12.2	6.2	11.2	13.2	17.2	...	+11.03
18	+ 6.2	+1.2	+3.7	+3.2	6.2	+ 3.2	—2.8	+12.2	11.2	13.2	5.2	12.2	12.2	17.2	...	+10.63
19	+ 0.2	—1.8	—1.3	+3.2	7.2	— 2.8	—1.8	+13.2	10.2	13.2	5.2	10.2	11.2	17.2	...	+ 9.37
20	— 3.8	+1.2	—0.8	+3.2	6.2	— 2.8	—1.8	+13.2	11.2	13.2	4.2	11.2	11.2	17.2	...	+ 8.82
21	— 5.8	+7.2	—0.8	+3.2	6.2	— 2.8	(—1 6)	+15.2	13.2	14.2	7.2	10.2	11.2	15.2	...	+ 8.45
22	— 2.8	+8.2	—3.8	+4.2	5.7	— 2.8	(—1.4)	+15.2	13.2	13.2	6.2	11.2	9.2	14.2	...	+ 7.65
23	— 6.8	+7.7	—7.8	+3.2	5.2	— 2.8	(—1.2)	+13.2	12.2	12.2	3.2	6.2	6.2	13.2	...	+ 6.35
Midn't	— 7.8	+8.2	—8.8	+3.2	+4.2	— 2.8	(—1 0)	+11.2	+12.2	+12.2	+ 2.2	+ 5.2	+ 6.2	+13.2	...	+ 5.93
Means	+ 5.12	+4.99	+1.51	—0.38	+4.60	+ 3.92	—1.88	+ 8.64	+13.08	+14.33	+ 8.74	+10.53	+ 9.78	+14.55	...	+ 9.74

Sept. 30th. First part of the day, wind blowing in heavy squalls.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In October, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. On deck of the brig Advance.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+14.2	+ 4.2	+17.2	+21.2	+17.2	+13.2	—1.8	+6.2	— 7.8	—24.8	—28.2	—4.5	— 1.5	— 6.0	+13.5	—10.5
2	14.2	4.2	16.7	21.2	18.2	+13.2	—0.8	+7.2	8.8	23.8	27.5	—3.5	— 0.5	— 6.0	+ 8.5	11.5
3	15.2	9.2	16.2	22.2	17.2	+13.2	—1.8	+3.2	7.8	22.8	26.5	—4.5	— 0.5	— 5.5	+ 4.5	10.5
4	13.2	9.2	16.2	22.2	18.2	+14.7	—2.8	+3.2	7.8	24.8	27.5	—2.5	+ 0.5	— 6.8	+ 4.9	11.5
5	14.2	9.2	18.2	21.2	19.2	+11.2	—4.8	+3.2	7.8	25.8	26.5	—2.5	+ 0.5	— 6.5	+ 4.5	11.5
6	12.2	9.2	19.2	20.2	21.2	+10.2	—3.8	+3.2	8.8	24.8	25.5	—1.5	— 1.0	— 7.5	+ 5.5	7.5
7	13.2	9.2	17.2	20.2	21.2	+ 9.2	—3.8	+3.2	10.8	25.3	22.5	—2.0	— 1.5	— 1.5	+ 7.5	7.5
8	13.2	10.2	19.2	22.2	19.2	+10.2	—3.8	+4.7	14.8	24.8	18.5	—1.0	— 1.5	— 1.5	+ 5.5	9.5
9	13.2	11.2	21.2	23.2	19.2	+10.2	—4.8	+2.2	11.8	25.8	16.5	+1.5	— 3.5	— 1.5	+ 3.5	8.5
10	15.2	10.7	21.2	23.2	19.2	+10.2	—6.8	+3.2	11.8	24.8	14.5	+3.5	— 4.5	+ 1.5	+ 2.5	9.5
11	14.2	9.2	21.2	23.2	20.2	+13.2	—7.3	+4.2	13.8	22.8	13.5	+3.3	— 4.5	— 1.5	— 2.5	9.5
Noon	15.2	10.2	21.7	23.2	19.2	+ 2.2	—5.8	—0.8	12.8	23.8	12.5	+3.3	— 7.0	— 1.5	— 3.5	12.5
13	15.2	11.7	21.2	23.2	19.2	+ 4.2	—4.8	+1.2	13.8	23.8	12.5	+4.5	— 7.0	— 1.8	— 3.7	14.5
14	13.2	12.2	23.2	23.2	20.2	+ 3.2	—2.8	—0.8	14.8	22.8	13.5	+4.5	— 9.0	— 1.5	— 4.3	15.5
15	10.2	13.2	23.2	21.2	20.7	+ 3.2	—3.3	—1.8	15.8	22.8	12.5	+1.7	—11.0	+ 0.1	— 4.5	18.0
16	10.2	14.7	23.2	20.2	19.7	+ 4.2	+0.2	—2.8	17.8	22.8	14.5	+1.7	—11.0	+ 0.1	— 5.5	15.5
17	9.2	17.2	21.2	17.2	19.2	+ 4.2	—1.8	—3.8	17.8	22.8	14.0	+0.5	—12.5	+ 1.5	— 7.5	17.5
18	8.2	16.2	19.2	16.2	19.2	+ 4.2	+0.2	—3.8	18.8	25.8	12.0	—2.0	—13.5	+ 2.5	— 7.5	17.5
19	9.2	17.2	18.2	15.2	19.2	+ 2.2	+1.2	—4.8	20.8	26.8	11.5	—1.5	—13.5	+ 3.5	— 7.5	19.0
20	9.2	16.2	20.2	17.2	19.2	+ 1.2	+0.2	—6.8	21.8	27.8	11.0	—1.5	—12.5	+ 4.5	— 7.0	19.5
21	9.2	15.2	21.2	18.2	17.2	+ 1.2	—0.8	—8.8	23.8	27.8	10.0	—1.5	—11.5	+ 1.5	— 6.5	17.5
22	8.7	15.2	22.2	20.2	17.2	— 0.8	—0.3	—6.8	22.8	28.8	10.0	—2.5	— 9.5	+ 1.5	— 6.8	18.0
23	7.2	14.2	22.2	19.2	16.2	— 1.8	+1.2	—8.8	23.8	29.3	5.5	—2.5	— 9.0	+12.5	— 8.5	18.0
Midn't	+ 6.2	+14.2	+21.2	+18.2	+13.2	— 1.8	+1.2	—8.8	—23.3	—29.3	— 5.5	—2.5	— 8.0	+12.5	— 8.5	—17.7
Means	+11.80	+11.80	+20.08	+20.53	+18.74	+ 6.43	—2.40	—0.57	—14.99	—25.20	—16.34	—0.48	— 6.38	— 0.31	— 0.97	—13.68

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—14.5	—11.5	—14.5	— 9.5	—21.5	(—16.2)	(—20.7)	—13.5	—16.0	—24.0	—25.5	—34.5	—27.0	—26.5	—22.0	— 8.89
2	14.5	8.5	10.5	12.3	21.5	(—14.8)	(—22.4)	14.0	16.0	24.5	25.6	32.5	27.0	22.3	21.0	— 8.59
3	15.5	8.2	7.9	13.5	22.0	—13.5	—24.0	10.0	17.0	25.5	26.0	36.5	29.0	22.0	22.0	— 8.76
4	15.5	8.0	6.7	15.5	21.5	13.0	23.5	9.0	18.0	26.5	27.0	34.5	27.0	20.0	21.0	— 8.65
5	14.5	8.0	6.5	13.5	19.2	13.2	24.0	5.0	18.0	26.5	28.0	35.5	24.0	20.0	20.0	— 8.38
6	13.5	7.9	6.0	13.5	19.5	13.4	24.0	3.0	22.0	18.0	28.0	37.8	23.0	19.0	20.0	— 8.00
7	11.5	7.5	6.5	13.5	20.0	16.0	18.0	4.0	22.5	17.0	31.0	37.0	27.0	18.0	19.5	— 7.84
8	14.0	8.5	6.5	14.0	21.7	15.0	14.0	7.5	22.0	15.0	32.0	37.0	27.0	18.0	20.0	— 7.85
9	13.5	12.5	6.5	14.0	20.5	13.0	13.0	9.0	22.0	17.0	34.0	34.0	23.5	18.3	21.0	— 7.70
10	14.5	8.5	6.8	13.2	20.0	10.5	12.5	9.5	23.0	23.0	33.5	25.0	20.0	17.5	22.5	— 7.15
11	14.5	8.5	10.0	16.7	19.5	9.0	12.0	9.5	25.0	27.0	34.8	20.0	20.0	19.5	23.0	— 7.60
Noon	14.5	8.5	7.5	17.9	19.5	8.0	11.0	9.0	26.0	30.0	34.5	19.5	20.0	20.0	22.0	— 8.16
13	15.5	10.5	7.5	18.0	19.0	8.0	11.0	9.0	26.0	32.5	34.0	15.5	20.0	21.0	22.0	— 8.10
14	16.5	13.5	8.0	17.5	18.5	8.0	12.0	7.0	25.5	32.0	34.5	14.7	22.0	22.5	22.0	— 8.37
15	18.0	14.0	3.5	18.5	17.5	8.5	11.0	5.5	24.5	29.0	34.0	16.0	21.0	23.0	18.0	— 8.33
16	19.5	14.9	3.5	19.0	18.5	9.5	13.0	3.0	22.0	22.0	34.0	18.0	23.0	24.0	19.0	— 8.34
17	18.5	13.5	4.5	17.0	18.5	11.0	13.0	4.5	23.4	24.0	33.5	14.0	24.0	25.3	19.5	— 8.76
18	18.5	17.5	4.5	17.5	18.5	9.0	14.0	5.3	24.0	26.0	31.0	19.0	21.0	26.3	20.0	— 9.26
19	20.5	17.5	8.7	19.7	18.5	11.0	14.0	6.5	27.0	26.0	29.0	22.5	26.0	27.0	22.0	—10.17
20	19.5	18.0	8.0	19.9	17.5	12.0	13.0	7.5	25.5	24.0	30.0	26.0	27.0	27.0	24.5	—10.30
21	15.5	18.5	7.5	20.5	17.5	13.0	13.0	7.0	22.0	24.5	30.0	27.0	30.0	25.5	24.0	—10.32
22	14.0	14.5	6.8	21.5	17.0	13.5	15.0	7.5	21.0	24.0	34.5	27.0	29.5	24.0	28.0	—10.29
23	12.5	13.5	6.5	20.5	18.5	18.0	15.0	9.0	18.0	25.0	36.0	28.0	29.0	24.0	30.0	—10.26
Midn't	—11.5	—11.5	— 7.5	—21.5	—17.5	—19.0	—15.0	—10.5	—23.0	—26.0	—36.0	—27.0	—30.0	—23.0	—30.5	—10.59
Means	—15.44	—11.81	— 7.18	—16.59	—19.31	—12.34	—15.75	— 7.72	—22.06	—24.54	—31.52	—26.60	—24.88	—22.24	—22.23	— 8.78

Oct. 11th. Shade thermometer No. 12 was withdrawn, and mercurial thermometer *B* substituted. From four comparisons with the spirit standard on shore, I deduced the correction +1°.5. This thermometer was used for 11 days.

Oct. 18th. The sun at meridian no longer reaches our brig.

Oct. 22d. Spirit thermometer *A* was used from this date. This thermometer was uniformly exposed in a wind protected case, suspended near foremast, 16 feet above water-line. From 16 comparisons, I deduce the correction +2°.0.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,
In November, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.
Expressed in degrees of Fahrenheit's scale. On deck of the brig Advance.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—30.5	—37.7	—24.0	...	...	...	...	...	...	...	—12.0	—20.5	—20.5	—28.5	—31.0	—32.0
2	31.0	35.5	27.0	...	...	...	...	...	...	...	12.5	21 0	20.0	28.0	32.0	29.0
3	29.0	35.5	26.5	...	...	...	...	...	...	...	12.0	22.0	19.0	28.0	31.0	29.0
4	30.0	35.5	26.5	...	...	...	...	...	...	...	13.0	22.6	21.0	30.0	32.0	28.0
5	31.0	36.5	26.0	...	...	...	...	...	...	...	13.0	21.0	21.1	28.0	33.3	37.0
6	31.0	38.0	26.2	...	...	...	...	...	...	...	13.0	19.0	21.4	29.0	34.3	37.5
7	30.0	33.0	26.7	...	...	...	...	...	...	...	12.8	21.0	19.8	27.0	34.4	33.0
8	32.0	31.5	25.0	...	...	...	...	...	...	...	19.3	21.5	23.9	25.5	35.3	33.5
9	24.0	32.0	31.0	...	...	...	...	...	...	...	21.5	16.6	23.0	25.5	34.0	34.8
10	27.0	33.0	30.0	...	...	...	...	...	...	...	22.0	17.5	22.1	22.5	36.0	35.0
11	19.0	31.0	27.0	...	...	...	...	...	...	...	19.0	16.5	25.5	25.5	35.5	35.0
Noon	18.5	31.0	23.5	...	...	...	...	...	...	...	20.5	14.5	26.0	26.0	33.5	35 0
13	18.0	24.0	26.0	...	...	...	...	...	...	...	22.0	14.6	24.0	27.0	37.0	36.0
14	18.0	24.5	28.0	...	...	...	...	...	...	...	22.0	15.0	24.5	27.0	38.0	37.0
15	18.5	27.0	30.0	...	...	...	...	...	...	...	21.5	17.0	25.0	27.0	38.5	37.0
16	18.5	29.5	28.0	...	...	...	...	...	...	...	21.8	18.0	26.0	26.0	39.0	37.5
17	23.0	30.5	30.0	...	...	...	...	...	...	...	22.0	15.8	28.0	26.4	38.0	36.0
18	25.0	29.0	32.0	...	...	...	...	...	...	...	23.0	13.5	29.0	27.2	38.0	36.4
19	29.2	31.0	34.0	...	...	...	...	...	...	...	21.5	15.5	24.3	28.7	39.0	38.0
20	31.0	30.5	35.5	...	...	...	...	...	...	...	22.0	16.0	26.0	30.0	37.0	38.2
21	32.0	33.0	36.5	...	...	...	...	...	...	...	21.0	16.0	27.0	32.0	37.0	39.0
22	30.0	34.0	37.0	...	...	...	...	...	...	...	21.0	15.0	26.5	32.5	37.0	38.0
23	35.0	36.0	38.0	...	...	...	...	...	...	...	21.0	15.0	25.0	33.0	34.0	40.0
Midn't	—36.0	—35.0	—39.0	...	...	...	...	...	...	...	—20.0	—16.5	—26.0	—32.0	—33.0	—40.0
Means	—26.97	—32.26	—29.72	—28.35 *	—26.98 *	—25.61 *	—24.23 *	—22.86 *	—21.48 *	—20.11 *	—18.73	—17.57	—23.94	—28.01	—35.33	—35.50

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	Means.	Corrected means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—38.5	—31.0	— 5.5	— 6.5	— 9.0	—16.0	—3.5	+7.0	0.0	— 5.7	—11.8	—18.0	—23.3	—36.8	—18.93	—19.90
2	39.0	33.0	6.0	— 3.0	10.0	14.0	—2.0	+6.5	— 2.0	6.7	15.0	19.9	23.3	35.7	—19.09	—20.03
3	41.0	33.0	7.0	— 2.0	12.0	14.3	—3.0	+3.0	1.5	6.7	17.5	21.5	21.7	35.1	—19.36	—20.28
4	41.5	31.0	6.0	— 2.0	13.0	14.5	—3.5	+3.0	2.0	8.8	17.9	20.5	20.5	35.2	—19.65	—20.54
5	41.0	(28.8)	10.3	— 2.0	15.8	12.0	—2.0	0.0	3.5	10.4	19.3	24.4	20.5	35.7	—20.55	—21.35
6	40.0	(26.6)	10.6	— 1.0	15.0	11.0	—2.0	+1.0	4.0	13.5	22.9	24.4	21.6	37.3	—20.80	—21.62
7	38.0	24.5	15.5	+ 1.0	15.0	12.0	—5.0	0.0	4.0	9.9	23.5	25.4	26.4	38.8	—20.64	—21.41
8	36.0	24.0	17.0	+ 1.0	17.0	12.0	—7.0	—4.0	3.0	13.0	22.0	25.6	23.8	40.1	—21.35	—22.05
9	36.0	25.0	18.0	0.0	17.5	11.5	—6.0	—1.5	5.0	11.8	21.5	25.6	24.9	40.8	—21.20	—21.90
10	35.0	24.5	19.0	+ 2.0	18.5	9.8	—7.0	—1.5	5.8	12.0	21.0	25.8	26.4	41.8	—21.36	—22.01
11	35.5	13.5	15.0	— 0.3	19.0	9.5	—3.3	—1.5	6.3	12.0	19.8	24.9	24.9	39.7	—19.97	—20.77
Noon	34.0	5.0	15.1	— 2.3	21.0	9.5	—4.7	—1.0	6.8†	15.5	19.5	24.4	26.4	37.8	—19.63	—20.48
13	36.0	4.0	15.0	— 0.7	24.0	9.0	—4.0	—0.5	8.0	17.0	18.9	24.4	30.4	43.2	—20.16	—20.98
14	34.0	3.5	17.5	— 1.0	24.0	8.8	—2.0	—0.5	7.5	17.0	19.5	25.8	31.5	39.7	—20.27	—21.09
15	32.0	3.5	18.0	— 1.5	23.0	8.0	+4.0	0.0	9.4	15.5	19.3	25.4	35.8	38.8	—20.33	—21.14
16	25.0	4.0	21.4	— 2.0	19.0	8.0	+2.0	0.0	14.3	15.5	19.4	25.5	41.9	39.7	—20.78	—21.58
17	25.0	2.1	22.0	— 2.0	16.0	7.0	+1.0	—2.0	14.5	17.5	19.0	24.7	43.2	41.6	—21.10	—21.90
18	24.0	4.0	23.0	— 4.0	16.0	7.6	+2.0	+1.0	14.5	17.0	19.3	27.7	43.7	42.1	—21.43	—22.23
19	25.5	4.5	15.0	— 5.0	16.0	7.4	+5.0	+1.0	11.4	16.5	19.5	28.4	45.6	45.6	—21.55	—22.39
20	26.0	5.0	16.0	— 7.0	19.0	6.0	+6.0	+1.0	9.9	11.4	19.7	29.1	47.9	39.7	—21.56	—22.43
21	34.0	4.7	18.0	— 6.5	19.7	6.0	+5.0	+0.5	11.4	11.4	19.2	26.9	47.3	39.3	—22.28	—23.10
22	32.0	4.0	16.3	— 7.3	19.0	6.7	+5.0	0.0	9.1	10.9	19.5	23.3	43.2	37.8	—21.53	—22.40
23	34.0	4.0	8.0	— 8.0	20.5	7.0	+5.4	—1.0	7.4	14.5	19.5	23.3	38.8	37.9	—21.55	—22.42
Midn't	—34.0	— 4.0	—12.0	—10.0	—21.0	— 6.0	+5.0	—0.5	— 7.4	—14.5	—22.0	—19.5	—35.7	—37.8	—21.60	—22.49
Means	—34.04	—14.47	—14.47	— 2.92	—17.50	— 9.73	—0.61	+0.42	— 7.03	—12.70	—19.44	—24.35	—32.03	—39.08	[—20.70]	—21.52

* Mean daily temperatures not given in Appendix XII. Vol. II. of the narrative. The above values are interpolated. On account of this, a correction was applied to the mean daily values (—0°.82). Besides this correction, a small one was applied to the hourly means to refer them to the middle of the month.

† From noon, Nov. 25th, the second spirit standard was used. From a number of comparisons, its corrections were found the same as those made out for spirit standard *S*.

Nov. 11th. The thermometer can hardly be observed at noonday without a light. Nov. 15th. Can read Parry's type at noon, but with great difficulty. Nov. 19th. Could not read the type at noon. Nov. 20th. Spirit standard and long ether thermometer on shore, and long mercurial standard on board, broken by last night's gale. Nov. 29th. Mercury congealed at —42°.7; resumes its fluidity at —38°.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In December, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. On deck of the brig Advance.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—35.7	—22.4	—35.7	—32.6	—40.8	—39.7	(—48.6)	(—43.2)	(—44.8)	(—41.7)	(—26 8)	(—52 8)	(—49.4)	—46.3	—47.9	—37.2
2	34.7	30.4	34.7	33.8	41.9	38.8	(41.7)	(42 6)	(44.0)	(41.8)	(27.1)	(51.6)	—50.4	43.2	47.2	37.3
3	43.2	29.5	35.7	32.6	41.9	40.8	—34.8	(42.0)	—43.2	—41.9	—27.4	—50.4	50.4	45.0	48.0	39.7
4	43.2	28.0	34.3	32.6	39.9	41.9	38.8	(41.4)	41.9	42.5	28.4	46.8	52.9	47.0	48.8	50.7
5	41.9	26.9	32.6	36.2	39.2	42.5	40.8	—40.8	(42.8)	(42.0)	27.4	41.8	51.6	47.9	48.2	42.3
6	39.7	26.8	31.5	34.2	37.8	42.6	41.9	41.8	(43.6)	(41.4)	29.5	40.0	45.0	47.3	48.0	41.8
7	43.7	34.8	29.0	35.8	44.4	42.8	41.4	41.2	44.5	40.8	25.9	31.9	37.8	46.1	51.6	45.6
8	44.5	35.7	27.3	36.8	38.2	43.2	41.6	43.2	43.8	38.7	25.6	31.5	38.2	46.1	49.4	45.0
9	43.2	29.5	22.4	35.8	37.2	41.9	38.8	45.9	42.7	41.1	29.1	32.5	39.0	49.1	47.9	49.3
10	41.9	29.5	20.5	34.8	37.3	39.0	40.8	44.6	42.8	41.3	29.5	31.0	38.8	49.5	47.9	50.4
11	40.8	30.0	23.3	37.5	35.8	38.8	39.3	43.2	40.8	40.0	32.0	27.9	37.8	51.2	48.6	46.8
Noon	39.3	31.5	20.0	35.8	33.1	43.7	40.5	43.2	39.0	39.7	35.1	26.9	35.0	52.4	47.9	46.0
13	43.2	35.7	15.5	35.8	32.6	44.7	40.8	42.3	38.3	39.7	37.8	28.4	35.7	53.3	46.8	46.8
14	43.2	33.8	17.0	36.8	32.6	45.6	42.5	41.3	41.9	37.5	39.1	28.7	37.8	52.9	46.4	47.5
15	36.8	41.3	18.7	37.2	31.5	45.0	43.4	40.3	(42.5)	37.3	40.8	28.7	37.2	50.0	47.3	47.6
16	32.5	41.9	18.5	37.8	30.5	44.4	44.2	34.8	(43.1)	37.6	48.4	30.8	37.8	50.4	41.4	47.3
17	32.5	41.9	19.5	39.0	29.7	43.6	44.5	31.1	43.7	38.0	49.1	30.8	38.1	51.6	40.2	47.3
18	33.2	43.2	20.0	35.2	29.5	45.1	44.0	29.2	44.6	32.0	49.1	31.5	38.8	52.1	39.7	45.2
19	33.5	42.5	20.5	36.8	30.5	44.5	44.1	34.5	41.9	36.8	50.7	31.8	39.1	51.6	44.5	45.6
20	29.0	38.5	19.5	38.6	31.5	44.5	—46.2	37.8	43.2	37.1	53.2	37.8	39.3	48.2	—50.8	45.9
21	26.1	37.8	29.0	38.3	31.8	44.5	(45.6)	40.2	41.2	27.7	56.2	42.5	52.1	46.0	(48.1)	45.6
22	21.5	36.2	32.6	38.1	32.5	44.8	(45.0)	42.3	—41.3	—25.9	—56.4	—46.3	46.5	42.5	(45.4)	45.1
23	17.5	37.6	32.8	40.2	35.8	51.8	(44 4)	43.2	(41.4)	(26 2)	(55.2)	(47.3)	40.3	41.3	(42.7)	39.7
Midn't	—16.7	—35.7	—32.8	—39.7	—38.0	—55.5	(—43.8)	—45.6	(—41.5)	(—26.5)	(—54.0)	(—48 4)	—39.7	—43.2	(—40.0)	—38.8
Means	—35.73	—34.42	—25.98	—36.33	—35.58	—43.74	—42.40	—40.65	—42.44	—37.30	—38.91	—37.42	—42.03	—48.09	—46.45	—44.77

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—36.8	—38.1	— 8.9	—19.7	—25.9	—19.7	—47.2	(—49.0)	—54.4	—47.9	—47.9	—29.0	—34.8	—18.5	—43.2	—37.63
2	33.8	38.8	12.5	20.0	24.4	18.1	47.6	—48.3	(50.6)	47.9	48.2	28.5	34.2	19.7	44.5	—37.36
3	29.5	40.8	13.0	24.8	23.8	18.0	(48.1)	50.4	46.8	46.1	47.9	28.2	35.8	20.5	44.8	—37.58
4	25.4	39.7	12.2	25.0	22.9	18.8	48.7	54.4	46.6	46.3	47.9	29.0	38.3	21.5	43.2	—38.03
5	29.4	35.3	11.0	24.3	22.4	22.4	49.4	51.6	47.5	44.8	47.6	26.4	37.8	19.5	40.1	—37.24
6	31.8	39.7	17.0	24.0	23.3	26.4	48.3	49.1	41.9	40.8	48.1	24.6	38.1	16.8	37.1	—36.77
7	43.9	40.9	12.0	23.0	23.3	37.8	51.6	46.8	39.7	39.7	47.9	22.4	38.8	15.0	32.6	—37.18
8	44.5	40.8	20.0	26.3	23.3	37.8	52.9	47.1	35.1	39.1	48.6	21.7	38.0	14.5	29.6	—37.04
9	42.6	24.1	22 2	23.0	22.9	41.8	52.9	47.3	33.1	38.3	45.6	21.4	37.3	14.0	26.3	—36.07
10	42.5	23.3	25.0	23.5	22.6	41.3	53.1	48.1	32.6	39.0	43.7	20.8	31.0	14.5	25.4	—35.68
11	42.5	21.6	25.3	22.7	21.6	43.2	52.9	49.1	29.5	39.7	42.5	20.5	27.4	16.5	24.0	—35.25
Noon	43.5	14.5	24.5	23.3	19.8	42.5	55.2	49.7	29.2	44.5	41.8	19.0	20.0	18.0	23.8	—34.79
13	46.2	14.0	23.3	34.0	17.5	41.8	52.9	49.1	29.2	44.5	42.3	19.5	20.4	19.5	23.4	—35.32
14	47.1	9.8	24.0	35.3	13.8	43.5	54.6	50.4	30.5	43.5	43.2	17.0	22.6	22.4	23.7	—35.84
15	47.9	7.0	25.5	34.8	11.4	41.8	54.5	51.0	33.2	45.6	42.3	15.8	24.9	28.9	22.8	—35.90
16	47.4	7.4	26.6	35.5	13.0	42.3	51.8	51.6	35.2	47.9	40.8	14.5	26.4	38.1	21.4	—36.17
17	45.6	8.0	26.2	35.7	14.1	43.7	50.7	54.0	35.1	48.3	41.1	17.4	23.3	41.6	22.7	—36.39
18	48.1	8.5	27.5	35.9	15.9	43.7	49.7	54.8	36.6	47.9	46.8	15.5	23.6	40.8	23.3	—36.48
19	45.6	9.4	27.0	35.8	18.5	45.0	51.0	58.3	40.2	47.3	34.8	19.5	22.4	42.5	23.6	—37.09
20	42.5	10.4	27.5	36.0	18.5	45.6	49.6	57.3	41.3	46.8	32.6	20.0	21.0	45.6	22.7	—37.05
21	43.2	11.6	(27.4)	37.0	(23.0)	45.6	(50.5)	56.9	43.4	46.3	31.5	22.4	19.5	45.6	22.4	—38.03
22	45.9	—12.7	(27.2)	34.8	27.4	45.6	51.3	59.1	43.7	45.8	29.0	22.8	17.5	45.6	24.4	—38.23
23	47.0	(11.4)	(27.1)	31.7	25.4	46.2	50.4	59.9	45.6	45.6	25.4	32.6	17.5	46.8	26.4	—37.95
Midn't	—44.5	(—10.1)	—26.0	—26.9	—21.9	—46.1	—49.8	—59.9	—47.2	—46.7	—28.5	—33.6	—17.9	—46.8	—26.4	—37.84
Means	—41.55	—21.58	—21.66	—28.88	—20.69	—37.45	—51.03	—52.22	—39.51	—44.60	—41.50	—22.59	—27.85	—28.05	—29.08	—36.79

Dec. 19th. From 3h. to 20h., the readings were supplied from thermometer *A*.

Dec. 20th. From 1h. to 14h., the readings were supplied from thermometer *A*.

TEMPERATURE OF THE AIR IN SHADE OBSERVED AT VAN RENSSELAER HARBOR,

In January, 1855, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. On deck of the brig Advance.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	16th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—25.4	—45.6	—38.4	—39.2	(—47.6)	(—34 4)	(—51.6)	—65.5*	—55.8	—40.8	—41.3	—44.9	—26.4	—19.5	—36.8	—31.5
2	25.4	43.7	37.8	39.4	—48.3	(34 6)	(52.2)	64.5	55.5	42.8	43.2	45.6	26.4	21.5	37.3	35.1
3	25.7	42.3	37.1	40.4	48.5	—34.8	—52.9	65.0	55.9	43.2	42.5	47.1	27.4	20.5	35.8	34.1
4	26.4	43.2†	37.3	41.8	48.7	34.2	54.8	64.5	55.9	41.8	42.3	47.9	27.0	20.7	35.8	34.8
5	26.9	43.7†	36.8	43.7	49 1	35.2	51.6	63.7	55.5	39.8	40.8	48.3	26.4	21.5	36.1	35.1
6	29.0	45.6†	37.1	44.8	48.3	38.1	50.0	62.9	57.6	39.0	39.0	49.1	25.7	22.4	35.3	35.3
7	30.5	47.9	37.3	46.8	47.9	43.7	47.3	63.1	58.7	39.2	34.8	50.4	24.9	23.7	33.8	35.8
8	22.7	47.6	36.8	46.6	44.5	43.2	50.4	58.3	58.3	35.7	30.0	49.7	23.4	24.4	37.1	38.3
9	34.1	46.8	36.3	49.4	42.3	43.2	50.7	56.2	56.0	35.2	24.4	47.9	24.4	23.4	30.5	41.4
10	34.8	47.1	35.7	49.6	43.5	45.0	51.1	55.5	56.9	35.0	23.4	45.6	17.5	23.4	31.0	39.7
11	36.3	47.3	35.7	51.3	42 3	49.9	50.9	55.8	57.5	34.8	21.5	43.2	14.5	23.4	31.5	39.3
Noon	37.1	42.5	36.8	49.6	41.8	54.6	50.4	55.8	57.7	35.1	18.5	41.8	10.4	23.4	30.5	36.7
13	37.5	43.2†	37.1	48.3	39.2	54.8	50.4	55.5	56.9	34.8	21.5	41.8	11.0	23.7	30.0	(35.5)
14	38.3	43.5†	37.8	48.1	38.8	54.6	51.0	55.5	56.6	35.1	27.3	41.8	10.7	23.4	29.5	(34.4)
15	38.8	43.7†	38.0	46.8	38.3	55.5	51.6	54.8	54.8	35.7	32.9	41.1	11,5	24.9	31.8	(33 2)
16	39.2	44.5†	38.3	47.1	37.8	56.1	52.9	54.6	54.2	36.8	36.3	40.8	11.8	25.4	32.6	(32.0)
17	38.8	44.5	39.2	45.6	36.0	56.2	53.5	54.2	51.6	37.1	38.9	41.8	12.8	25.7	33.0	(30.9)
18	38.1	46.5	39.7	45.0	35.7	58.5	56.9	55.0	48.5	37.8	39.7	42.5	14.0	26.4	32.0	(29 8)
19	34.8	43.2†	40.7	45.0	35.2	58.3	61.4	56.2	49.9	38.8	41.0	40.8	16.5	26.9	31.5	28.7
20	35.1	41.3†	41.0	46.2	32.6	56.2	61.6	53.5	51.5	39.2	43.2	40.8	17.8	27.7	32.0	28.5
21	34.0	40.8	40.8	48.1	32.4	56.9	64.4	52.9	49.7	37.8	43.2	46.0	18.5	(29.5)	(31.9)	28.0
22	34.8	41.1	40.8	46.2	34.8	(54.9)	64.3	53.5	47.4	39.7	44.5	34.8	19.0	(31.3)	(31.8)	27.9
23	40.1	39.2	40.8	46.8	34.6	52.9	64.4	53.8	43.2	40.2	44.5	31.0	19.0	(33.1)	(31.7)	37.7
Midn't	—46.0	—39.0	—39.7	—47.0	—34.2	—51.0	—65.3	—55.1	—40.0	—40.8	—44.5	—27.8	—19.3	(—34.9)	(—31.6)	(—35.1)
Means	—33.74	—43.91	—38.21	—45.95	—40.93	—48.20	—54.65	—57.77	—53.57	—38.17	—35.80	—43.02	—19.01	—25.03	—32.95	—34.12

Hour.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.	Means.	Corrected means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	—32.5	—23.3	—25.9	—18.5	—36.3	—26.4	—35.0	—24.4	...	...	...	...	...	...	...	—36.13	—28.28
2	30.5	18.5	26.2	20.5	36.4	27.9	34.9	22.4	...	...	...	...	...	...	...	—36.27	—28.40
3	30.0	17.5	23.5	27.4	33.8	31.5	33.8	21.4	...	...	...	...	...	...	...	—36.34	—28.44
4	27.4	19.5	23.3	25.9	33.8	32.0	33.1	22.4	...	...	...	...	...	...	...	—36.44	—28.47
5	27.7	(19.7)	(23.7)	(26.5)	(33.2)	(33.0)	(32.6)	20.5	...	...	...	...	...	...	...	—36.30	—28.41
6	26.9	(19.8)	(24.0)	(27.0)	(32.5)	(33.9)	(32.0)	20.5	...	...	...	...	...	...	...	—36.49	—28.64
7	26.4	20.0	24.4	(27.5)	(31.9)	(34.9)	(31.5)	20.0	...	...	...	...	...	...	...	—36.77	—28.85
8	26.9	20.5	22.9	(28.0)	(31.2)	(35.8)	(31.0)	19.5	...	...	...	...	...	...	...	—35.95	—27.98
9	26.4	22.4	21.4	28.5	30.5	36.8	30.5	18.5	...	...	...	...	...	...	...	—35.72	—27.76
10	25.4	21.5	21.9	28.5	30.5	36.8	31.5	17.5	...	...	...	...	...	...	...	—35.35	—27.37
11	6.5‡	23.3	22.4	28.5	28.4	36.8	32.5	15.5	...	...	...	...	...	...	...	—34.55	—26.59
Noon	5.0	23.8	23.3	27.4	27.9	37.6	33.8	13.5	...	...	...	...	...	...	...	—33.96	—25.98
13	(6.2)	(22.8)	(23.0)	(27.7)	(27.4)	(38.2)	34.0	12.5	...	...	...	...	...	...	...	—33.88	—25.79
14	(7.4)	(21.8)	(22 6)	(28.0)	(26 9)	(38.8)	33.8	11.0	...	...	...	...	...	...	...	—34.03	—25.92
15	(8.5)	(20.7)	(22.2)	(28.3)	(26 4)	(39.5)	34.0	8.6	...	...	...	...	...	...	...	—34.23	—26.09
16	(9.7)	(19.7)	(21.8)	(28.7)	(25.9)	(40.1)	33.8	7.4	...	...	...	...	...	...	...	—34.48	—26.32
17	(10.9)	18.6	21.4	29.0	25.4	40.8	34.3	(—6.3)	...	...	...	...	...	...	...	—34.44	—26.32
18	(12.1)	19.5	22.0	29.5	24.9	41.4	33.8	(—5.2)	...	...	...	...	...	...	...	—34.77	—26.68
19	(13.3)	16.5	(22 6)	(30.5)	(25.1)	(40.5)	(32.5)	(—4 1)	...	...	...	...	...	...	...	—34.33	—26.16
20	(14.5)	17.3	(23.2)	(31.5)	(25.3)	(39.6)	(31.3)	(—3.0)	...	...	...	...	...	...	...	—34.75	—26.61
21	15.7	(19.0)	(23.8)	(32.4)	(25.5)	(38.7)	30.0	(—1.9)	...	...	...	...	...	...	...	—35.08	—26.94
22	17.5	(20.7)	24.4	(33.4)	(25.7)	(37.8)	28.6	(—0.8)	...	...	...	...	...	...	...	—34.82	—26.72
23	28.4	(22.4)	26.7	(34.4)	(26.0)	(36.8)	27.2	(+0.3)	...	...	...	...	...	...	...	—35.61	—27.55
Midn't	—22.4	(—24.1)	—25.4	(—35.3)	(—26 2)	(—35.9)	26.9	(+1.4)	...	...	...	...	...	...	...	—35.25	—27.21
Means	—19.05	—20.12	—23.42	—28.45	—29.05	—36.31	—32.18	—12.30	+14.62 §	—0.98 §	+3.30 §	+6.45 §	+4.72 §	—7.20 §	—19.08 §	[—35.25]	—27.23

* Lowest temperature observed this winter. † Readiugs supplied from thermometer *C*. ‡ Blowing hard between 10h. and 12h.

§ Means supplied from the second volume of the narrative, the values being corrected by +1°.34, from comparisons on Jan. 13th.

The constant correction applied to the last vertical column is —27°.23 +35°.25 = +8°.02, to which has been added small corrections to refer the dinrnal variation and the means to the middle of the month.

The following is an example (of a somewhat extreme case) of the method of interpolation adopted in the preceding abstract. Required, the hourly temperatures between, 1854, April 2d, $20^{h.}$, and April 3d, $13^{h.}$. The monthly means of each hour (omitting the observations on the 2d and 3d) were first compared with their monthly mean, when the mean diurnal variation (for the 15th of the month) became known. In like manner, the variation for the preceding month was obtained; and then, by a simple interpolation, the mean diurnal variation for the time between the 2d and 3d was found. Let $v_1\ v_2\ v_3\ v_4 - - - v_{24}$ equal the hourly values of the diurnal variation, t equal the mean temperature, and T resulting or interpolated temperatures; then $T = t + v\ p$, where p a factor depending principally on the transparency of the atmosphere. To find the hourly values of t and p for the above interval, we select a convenient number of consecutive observations before and after the interval, which, in the present case, gives the equations—

April 2,			April 3,	
$15^{h.}$	$-21.2 = t + 3.7\ p$		$13^{h.}$	$-26.9 = t + 3.4\ p$
16	$-22.3 = t + 3.2\ p$		14	$-26.5 = t + 4.0\ p$
17	$-23.0 = t + 2.8\ p$		15	$-24.0 = t + 3.7\ p$
18	$-25.0 = t + 2.1\ p$		16	$-25.8 = t + 3.2\ p$
19	$-28.0 = t + 1.1\ p$		17	$-29.0 = t + 2.8\ p$
20	$-27.0 = t + 0\ 2\ p$		18	$-30.4 = t + 2.1\ p$
Mean	$-24.4 = t + 2.2\ p$			$-27.1 = t + 3.2\ p$
And from comparison with each equation	$t = -29.1$, $p = 2.14$	for $17\frac{1}{2}^{h.}$		$t = -36.8$, $p = 3.03$ for $15\frac{1}{2}^{h.}$

Hence, hourly variation in t $-0°.35$, and in p $-0°.04$.

The above sets of equations were then corrected for this hourly change of t and p, when the following corrected results were obtained:—

$t = -27.9$	$t = -33.2$
$p = 1.60$	$p = 1.90$

These values, when substituted in the equations, leave the following residuals:—

In first set	-0.1	-0.1	$+0.2$	-0.3	-1.3	$+1.5$	Prob. error of each $\pm 0°.6$
In second set	-1.1	-1.5	$+2.0$	$+1.5$	-0.5	-0.3	" " ± 1.0

The true hourly variation in t becomes $-0°.24$

" " p " -0.01

The following table contains the interpolated values of t and p, and the resulting hourly temperatures for the interval.

1854	t	v	p	T	1854	t	v	p	T
April 2, $21^{h.}$	$-28°.7$	$-0°.7$	$1°.65$	$-29°.9$	April 3, $5^{h.}$	$-30°.6$	$-2°.9$	$1°.75$	$-35°.6$
22	-29.0	-1.6	1.66	-31.7	6	-30.9	-2.4	1.77	-35.2
23	-29.2	-2.1	1.68	-32.8	7	-31.1	-1.6	1.79	-33.9
24	-29.5	-2.8	1.69	-34.2	8	-31.3	-0.7	1.80	-32.6
April 3, 1	-29.7	-3.4	1.70	-35.5	9	-31.6	$+0.7$	1.82	-30.3
2	-29.9	-3.4	1.72	-35.8	10	-31.8	$+1.5$	1.83	-29.1
3	-30.2	-3.6	1.73	-36.4	11	-32.0	$+2.4$	1.85	-27.6
4	-30.4	-3.4	1.74	-36.3	12	-32.3	$+3.0$	1.86	-26.7

Which values in the last column will be found in their proper place in the preceding abstract.

Diurnal Variation.—Before giving the table of the diurnal change of the atmospheric temperatures, it will be proper to remark that, astronomically, the upper limb of the sun ceases to be visible at noon on Oct. 25th, and reappears at noon Feb. 16th; between April 19th and Aug. 24th, the lower limb will continue above the horizon without setting. On account of the considerable annual variation of the temperature, the figures in the last vertical column of each month in the preceding abstracts, headed "mean," require a small correction for the effect of the annual change during twenty-four hours; they will then represent the diurnal variation for the middle of each month. Thus, for September, 1853, the effect of the annual change during twenty-four hours is 0°.50 decreasing, hence the maximum corrections applied are —0°.25 and +0°.25 for $1^{h.}$ and $24^{h.}$ respectively; and for the intermediate hours an aliquot part of this is applied, according to the interval from noon, where the correction is zero. The following table presents the summary of the diurnal variation for each month of the year; for the first five months, the figures are the mean from two sets. The highest and lowest values, for better distinction, are placed between parentheses.

Mean Diurnal Variation of the Temperature for the middle of each Month of the Year.

Hour.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.	July.	August.
	°	°	°	°	°	°	°	°	°	°	°	°
1	(+10.92)	—3.76	—21.51	—31.54	—28.04	(—34.36)	—38.56	—11.77	(+ 9.31)	(+27.21)	+36.67	(+28.99)
2	10.97	3.79	21.54	31.39	28.49	34.32	38.40	11.82	9.62	27.25	36.76	29.33
3	11.28	3.74	21.46	31.65	28.62	34.14	38.61	(12.26)	10.26	27.40	36.79	29.27
4	11.21	3.58	21.42	(31.82)	28.67	33.54	(38.86)	11.77	10.78	27.71	36.78	29.67
5	11.23	3.47	22.00	30.97	28.66	34.20	38.81	10.96	12.05	28.98	36.94	29.55
6	11.85	3.47	(22.35)	30.83	28.71	33.62	38.60	10.33	12.91	29.61	37.60	30.17
7	12.87	3.29	22.13	30.97	(29.02)	33.19	37.91	9.32	13.64	30.46	37.76	30.83
8	14.32	3.32	22.27	31.04	28.43	32.87	37.52	8.28	14.56	31.69	38.43	31.84
9	15.07	3.00	22.06	30.69	28.56	32.63	36.23	6.64	14.45	30.89	39.42	32.96
10	15.75	(2.72)	22.18	30.68	28.29	32.10	35.68	6.00	15.11	31.08	39.63	33.83
11	16.15	2.81	21.68	30.52	27.75	32.42	34.51	5.07	15.38	31.43	40.00	34.00
Noon	16.40	2.97	(21.37)	(30.04)	(27.26)	31.79	33.97	4.46	15.89	32.18	(40.04)	34.20
13	(16.47)	3.03	21.73	30.12	27.55	31.30	33.60	4.05	16.09	(32.31)	39.83	34.26
14	16.12	3.18	21.72	30.44	27.57	(31.29)	(33.20)	3.27	16.31	32.17	39.69	(34.29)
15	15.65	3.08	21.77	30.77	28.08	31.44	33.86	(3.17)	16.38	31.85	39.65	33.90
16	15.11	3.18	21.86	31.08	28.32	31.52	34.97	3.51	(16.65)	31.52	39.65	33.38
17	14.51	3.43	21.69	31.18	28.00	31.78	35.67	3.67	16.04	31.31	38.85	33.11
18	14.07	3.79	21.93	31.32	28.00	31.64	36.32	4.57	15.17	31.08	38.50	32.62
19	13.28	4.28	22.06	31.53	27.87	31.58	36.85	6.01	14.29	30.66	38.23	32.25
20	12.78	4.36	22.14	(31.81)	28.18	31.73	37.75	7.01	13.41	30.41	37.66	31.91
21	12.46	4.34	(22.64)	31.74	28.09	32.15	37.90	8.37	12.56	29.75	37.22	31.63
22	12.07	4.38	22.30	31.62	28.01	33.22	38.17	9.94	11.43	29.30	(36.65)	31.00
23	11.36	4.34	22.54	31.51	(28.66)	33.25	38.42	10.71	10.37	28.38	36.81	30.63
Midn't	+11.05	(—4.39)	—22.37	—31.35	—28.34	—33.53	—38.61	—11.87	+ 9.90	+27.98	+36.92	+30.07
Mean	+13.45	—3.57	—21.95	—31.12	—28.22	—32.65	—36.79	— 7.70	+13.45	+30.12	+38.19	+31.82
Amplitude	5.55	1.67	*1.00	*1.65	*1.55	3.07	5.66	9.09	7.34	5.10	3.37	5.30

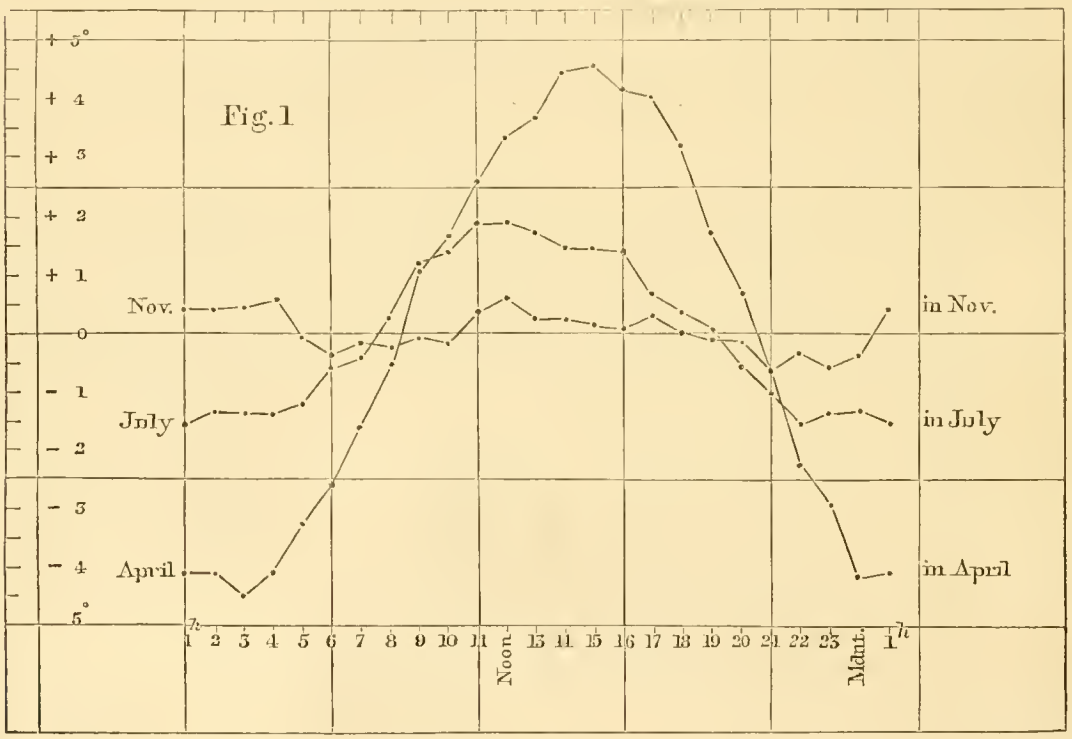
* The amplitude for November, December, and January, was derived from a graphical representation of the hourly values through which a curve was thrown with a free hand in order to eliminate the effect of the accidental variations, which, during these months, approach in magnitude to the range of the diurnal variation itself.

According to the preceding table, the epoch of the diurnal maximum temperature occurs in the months of October and November (when the diurnal amplitude is a minimum) about one hour before noon, and in April and May (when the diurnal

amplitude is a maximum) about three hours after noon, the whole mean range (obtained graphically) being four hours during the year. In the months of November, December, and January, there are two minima, one at about 6 A. M. (whether this represents the primary or secondary minimum cannot well be decided from these observations alone), and the other at about 9 P. M. During the remaining months of the year, there is but one minimum during twenty-four hours, which occurs at 1 A. M.

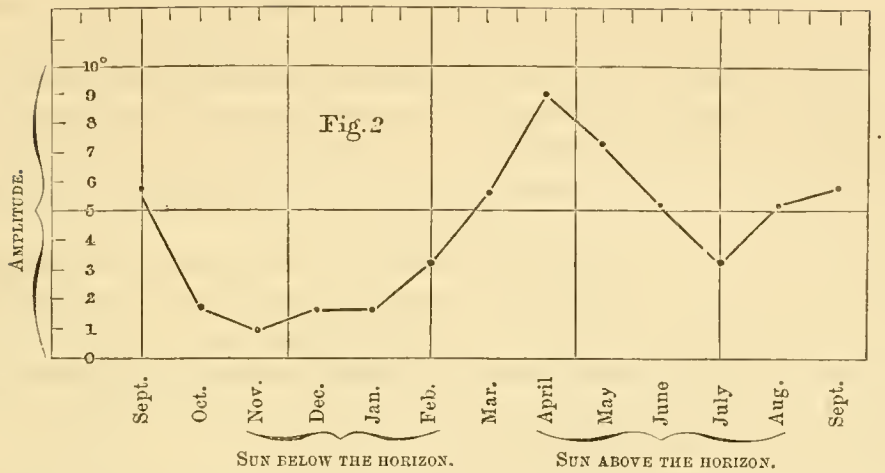
At about 7½ in the morning, and a little before 8 in the afternoon, the temperature equals the mean temperature of the day, excepting the months of November, December, and January. The greatest deviations from these hours are ±1½ hours. For the remaining three months, the means are reached at 9½ in the morning, and also between 4 and 10 in the afternoon; the latter (as well as another hour at about 4 A. M.) being very irregular.

For three months of the year, the diurnal variation is exhibited graphically.



The diagram shows the maximum diurnal variation in the month of April, the secondary minimum variation in the month of July, and the diurnal variation in the month of November when nearest to its absolute minimum. ± indicates a $\left\{\begin{matrix}\text{higher}\\\text{lower}\end{matrix}\right\}$ temperature than the mean of the day. The month of November exhibits considerable anomalies. In July the sun never set, and in November he never rose above the horizon.

In the following diagram, I have exhibited the annual march of the diurnal amplitude for each month.



The absolute maximum value of the amplitude was observed in April (9°.09), and the absolute minimum in November (1°.00); the diurnal variation never disappearing altogether, although the sun remained for $2\frac{2}{3}$ months below the horizon. A secondary minimum was reached in July (3°.37), somewhat later than the middle of the time the sun made his circuit round the points of the compass without setting.[1] The mean amplitude of the diurnal variation during the whole year is 4°.20—the maximum rising 4°.9 above, and the minimum falling 3°.2 below. The daily range of the effect of the thermal wave propagated northward during the long arctic darkness, may be set down to 1°.6 on the average.

For the purpose of comparing with similar results at other stations, I add a table of the mean daily variation during the year. Each figure is simply the mean of the twelve values corresponding to the same hour, and was taken from the preceding table. No attention was paid to the small anomalies noticed in three winter months, which cannot sensibly affect the means. The second column contains the mean values, and the third the same after the general mean has been subtracted from each of them, and, consequently shows the mean variation proper, $\pm$ indicating a $\left\{\begin{matrix}\text{higher}\\\text{lower}\end{matrix}\right\}$ value than the mean. The fourth column exhibits the hourly differences of the variation.

Mean Diurnal Variation for the Year, derived from its Monthly Values.

Hour.	Mean temperature.	Diurnal variation.	Its hourly difference.	Hour.	Mean temperature.	Diurnal variation.	Its hourly difference.
1	—4°.70	—1°.79	—0°.05	13	—1.°04	+1°.87	—0°.03
2	—4.65	—1.74	—0.03	14	—1.01	+1.90	+0.22
3	—4.62	—1.71	—0.16	15	—1.23	+1.68	+0.28
4	—4.46	—1.55	—0.27	16	—1.51	+1.40	+0.29
5	—4.19	—1.28	—0.38	17	—1.80	+1.11	+0.38
6	—3.81	—0.90	—0.45	18	—2.18	+0.73	+0.44
7	—3.36	—0.45	—0.62	19	—2.62	+0.29	+0.45
8	—2.74	+0.17	—0.57	20	—3.07	—0.16	+0.40
9	—2.17	+0.74	—0.32	21	—3.47	—0.56	+0.46
10	—1.85	+1.06	—0.37	22	—3.93	—1.02	+0.39
11	—1.48	+1.43	—0.38	23	—4.32	—1.41	+0.23
Noon	—1.10	+1.81	—0.06	Midn't	—4.55	—1.64	+0.15

[1] A more complete understanding of the diurnal variation can only be had in connection with hygrometric observations.

Accordingly the mean is reached at $7^{h}.7$ A. M. and $7^{h}.6$ P. M; the maximum at 2 P. M., and the minimum at 1 A. M. The mean range equals 3°.69, a quantity necessarily smaller than the mean amplitude for the whole year as given above. Maximum mean hourly difference or change 0°.62 between 7^{h} and 8^{h} A. M., and 0°.45 between the same hours P. M.

We now return to the last vertical columns of the general monthly abstracts, and examine the

Observed Hours of Mean Daily Temperature.—The following table contains the hours of the day when the temperature equals its mean daily value, made out for each month of the year. Also shows their difference, or the "critical interval." These values are derived directly from the general abstracts of observed temperatures, and, for the first five months, are mean values derived from two sets of observations in the first and second years.

Month.	Morning hour.	Evening hour.	Critical interval.	Month.	Morning hour.	Evening hour.	Critical interval.
September . .	7.4	18.4	$11^{h}.0$	April	8.4	20.7	12.3
October . . .	Uncertain,	17.1	11.1	May	6.9	20.2	13.3
November . .	probably one	Uncertain, one		June	6.7	20.7	14.0
December . .	near 3^{h}., the	near 15^{h}., the	12.0	July	7.6	19.1	11.5
January . . .	other near 9^{h}.	other near 21^{h}.		August . . .	7.9	19.8	11.9
February . .	8.9	21.4	12.5				
March . . .	8.5	19.1	10.6	Means . . .	7.2	19.2	12.0

In the following table, I have exhibited the greatest absolute changes of temperature observed between any two successive hours, between the highest and lowest of any day of 24 consecutive hours, any month, and for the whole year.

Month.	Hourly.	Daily.	Monthly.	Month.	Hourly.	Daily.	Monthly.
September . . .	7°.0	15°.6	32°.3	June	8°.0	15°.0	24°.2
October	8.0	24.1	41.0	July	8.0	14.6	23.0
November . . .	10.8	25.0	42.8	August	8.0	20.8	29.8
December . . .	19.4	30.4	60.5	September . . .	16.0	24.0	36.0
January	8.1	21.8	69.8	October	11.0	25.0	61.0
February . . .	12.3	37.8	56.4	November . . .	11.0	32.0	54.9
March	13.5	24.1	56.7	December . . .	16.7	41.1	52.9
April	10.0	33.1	56.7	January	18.9	35.6	81.6
May	7.8	17.8	46.5				
				Means	11.4	25.7	48.6

The following values are the absolute maximum and minima observed:—

Minimum in winter, 1853–54 . . . . . —66°.4, observed on Feb. 5th
Maximum in summer, 1854 . . . . . +51.0, " July 23d
Minimum in winter, 1854–55 . . . . . —65.5, " Jan. 8th

Absolute maximum difference, 117°.4 Fahr.

Mean Monthly Temperatures and Annual Variation.—In the following recapitulation of the mean monthly temperatures, the values have been taken directly from the general abstracts. The means for the months of February, March, and April, of 1855, have been added by means of the table given in Vol. II. of the Narrative, p. 425, corrected from ten comparisons of monthly means between —14° and —34°, so as to refer the quantities to the same system of corrections as used in the present

paper. This correction, from consistent separate values, is +0°.99. On account of the occasional omissions of observations in the hourly abstract, the daily means in the Narrative for these three months are probably not reliable, the calculator, as has been found on other occasions, having paid no attention to such omissions in taking his mean; the monthly means may, nevertheless, be nearly correct.

MEAN MONTHLY TEMPERATURES AT VAN RENSSELAER HARBOR.

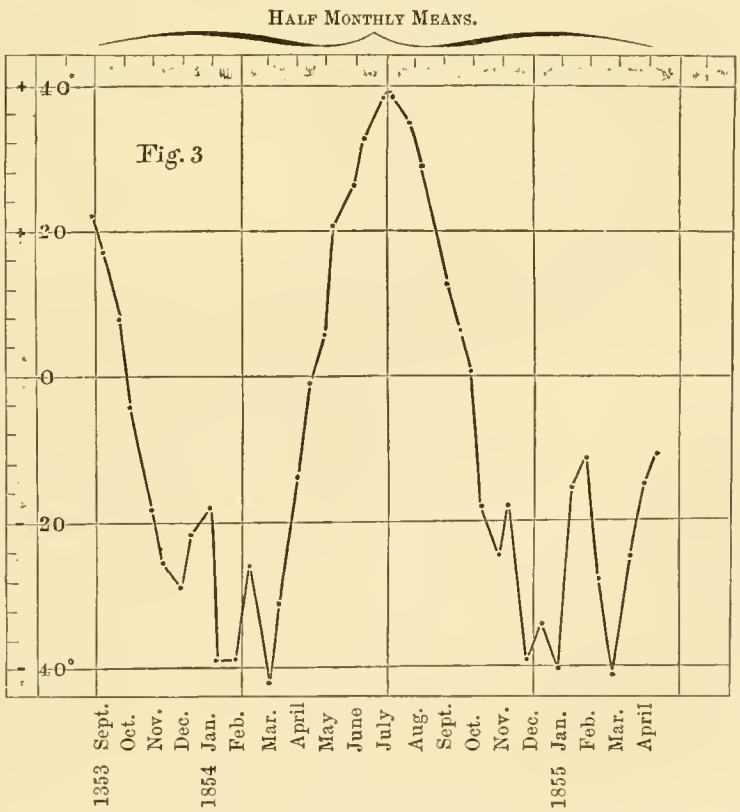
(Degrees of Fahrenheit's scale.)

1853	September	+17°.16	1854	July	+38°.19
	October	+ 1.62		August	+31.82
	November	—22.39		September	+ 9.74
	December	—25.46		October	— 8.78
1854	January	—29.21		November	—21.52
	February	—32.65		December	—36.79
	March	—36.79	1855	January	—27.23
	April	— 7.69		February	—20.22
	May	+13.45		March	—32.98
	June	+30.12		April	—13.01

If we unite the temperatures for the same months in one mean, we obtain the following mean temperatures for each month of the year:—

1853–54	September	+13.°45	1854–55	March	—34°.88
	October	— 3.58		April	—10.35
	November	—21.95	1854	May	+13.45
	December	—31.12		June	+30.12
1854–55	January	—28.22		July	+38.19
	February	—26.43		August	+31.82

These values, when thrown into a curve, present a great regularity during the summer months; not so, however, during the winter months, when the direct effect of the sun is very feeble, and the winds probably become the main source of the variability of temperature. To exhibit this difference in the variation of the summer and winter temperatures, I have graphically presented the half monthly means, when the steadiness of the summer curve becomes very striking.



It must be considered a fortunate circumstance that the observations extend over *two* winters, and thus give us a more exact mean temperature for that season.

The warmest month is July, and the coldest is March; the temperature of December, however, does not differ much from it, and December actually was the coldest month in the second winter. The highest mean monthly temperature seems to fall almost exactly to the middle of July, and the lowest would probably occur in February, if we had a longer series of observations extending over several winters. From the observations on hand, we find the December temperature only $3\frac{3}{4}°$ higher than the March temperature. The range of the mean temperature for the warmest and coldest month is 73°.07. The temperatures for the meteorological seasons—December, January, and February being regarded as winter—become as follows:—

Winter	—28°.59	Mean temperature for the whole year, —2°.46.
Spring	—10.59	
Summer	+33.38	
Autumn	— 4.03	

The mean annual temperature is reached in the middle of spring (April), and again in the middle of autumn (October). The difference in the winter and summer temperature is 61°.97.

The seasons of the second year compare with the corresponding ones of the first as follows:—

Autumn in the second year colder by	5°.65
Winter " " warmer by	1.03
First two months of spring colder by	0.76

The lowest mean monthly temperature of the first winter (March, —36°.79) was precisely the same as that of the second winter (December, —36°.79), both months falling in the year 1854.

For the purpose of continuing the discussion of the atmospheric temperatures, it becomes necessary to express the annual variation analytically. On account of the great range of this variation, I have first applied a small correction to the preceding monthly means, in order to refer them to the middle of months of average length of $30^d.4$ in common, and $30^d.5$ in leap years. Thus, the mean temperature of January, 1854, refers to (noon) $15^d.5$, when it ought to refer to $15^d.2$; difference, $0^d.3$. The fifteenth part of the difference of the January half monthly means is —1°.40; hence the correction +0°.40. For convenience of reference, the number of days for which a correction is to be applied to refer the means of the true to an average month are here inserted. Commencing with January, these numbers for the several months in their proper order become—

$-0^d.3$	+0.6	+1.5	+1.5	+1.4	+1.3	+1.2	+0.7	+0.6	+0.5	+0.4	$+0^d.3$
—0.2	+0.2	+0.8	+0.8	+0.8	+0.8	+0.8	+0.2	+0.2	+0.2	+0.2	+0.2

The first line is for a common year, the second for a leap year. The maximum correction applied was +1°.34 (to the mean of March). To the following monthly

means, referring to months of an average length, I have added the probable uncertainty obtained by comparison with the daily means.

January . . .	—28°.26	±1°.5	July	+38°.18	±0°.3
February . . .	—26.53	±1.4	August . . .	+31.59	±0.4
March . . .	—33.54	±1.3	September . .	—13.15	±0.6
April . . .	— 9.48	±1.2	October . . .	— 4.13	±1.1
May . . .	+14.78	±1.2	November . . .	—21.96	±0.9
June . . .	+30.76	±0.5	December . . .	—31.00	±0.9
Annual mean from 12 average months				— 2 20	±0.3

For the purpose of interpolation, and for the representation of the annual variation, a function involving terms of the sine or cosine of multiples of an angle is usually adopted. In the present case, I prefer a form of discussion which makes the law of the change of the monthly temperatures analogous to that of a falling body. This method was adopted by Mr. J. Wiessner, and applied to the discussion of the Washington observations. (See p. 322 of the Annual Report of the Regents of the Smithsonian Institution for 1857.) The annual variation may thus be represented by a parabolic wave. The diurnal variation has previously been represented by others by parabolic arcs. Whatever form of expression we may adopt, the winter curve is so irregular, owing to the short number of observations, that no continuous law can be deduced; the temperatures during this season will, therefore, be treated separately. If the observations were continued for several years, it is probable that the lowest temperature would fall in February, near the time of sunrise; as it is, we have a slight increase of temperature during January and February.

A uniformly retarded motion is represented by $s = ct - \frac{1}{2}gt^2$, and the condition for the turning point is $o = c - gt$, corresponding to the middle of July, or the third month, commencing with the middle of April as zero. For $t = 3$, $c = 3g$, and, putting for convenience $g = 2$, we find $c = 6$; hence, if $t =$ number of months after the middle of April, the arguments for the several months become—

0 1 2 3 2 1 0 —1 —2 —3 —2 —1 0

the temperature in April being the same as in June, etc. Substituting these numbers successively in the formula $s = 6t - t^2$, we find the values (R) 0, 5, 8, 9, 8 ..... for the months of April, May, June — ..... Each month furnishes an equation of the form $T = t_m + Rp$, where $t_m =$ the mean temperature and p a factor depending on the amplitude of the annual variation. t_m and p, when found for spring, summer, and autumn, are found to vary, and hence an interpolation is made for each month. We have next to introduce a second term to allow for a shifting of the epoch. Let x be the quantity addition to the arguments 0 1 2 3 2, etc., for the change in the epoch, and expressed in parts of a month, we have for—

$0 + x$	$s = 6\,(0 + x) - (0 + x)^2$	or $s = 0 + 6x$
$1 + x$	$6\,(1 + x) - (1 + x)^2$	$5 + 4x$
$2 + x$	$6\,(2 + x) - (2 + x)^2$, etc.	$8 + 2x$, etc.

omitting terms containing the second power of x. Putting $px = q$, we obtain, in place of the first expression for the temperature—

$$T = t_m + Rp + Q_1$$

For the day or summer period we thus obtain the equations:—

May	$+14°.78 = t_m + 5p + 4q$	Whence $t_m = -15°.73$, $p = 5.918$, and $q =$
June	$+30.76 = t_m + 8p + 2q$	$+0.12$ as resulting from the normal equations.
July	$+38.18 = t_m + 9p$	$T = -15°.73 + 5.918\,R + 0.12\,Q \pm 0°.7$
August	$+31.59 = t_m + 8p - 2q$	
September	$+13.15 = t_m + 5p - 4q$	

For the spring months:—

March	$-33°.54 = t_m - 5p + 4q$	$T = -9°.18 + 4.832\,R - 0.05\,Q$
April	$-\ 9.48 = t_m \quad + 6q$	
May	$+14.78 = t_m + 5p + 4q$	

For the autumn months:—

September	$+13°.15 = t_m + 5p - 4q$	$T = -4.91 + 3.510\,R - 0.13\,Q$
October	$-\ 4.13 = t_m \quad - 6q$	
November	$-21.96 = t_m - 5p - 4q$	

The above 3 values for t_m, p, and q are represented by the formulæ:—

$t_m = -15.73 + 0.71n + 0.96n^2$
$p = +\ 5.918 - 0.220n - 0.1942n^2$
$q = +\ 0.12 - 0.01n - 0.022n^2$

Where n = number of months from the middle of July. For March $n = -2$; for Nov. $+2$.

The following table contains their computed values for each month (under discussion).

Month.	t_m	p	q		Obs. — comp. temperatures.
March	—13°.31	4.082 (—0.750)	+0.06	If we now compare the computed and observed temperatures for each month, we yet find a constant correction to t_m of $+0°.14$. Applying it to the tabular quantities, the formulæ represent the observations as follows:—	—0.°20
April	— 9.18	4.832 (—0.750)	—0.05		—0.14
May	—13.31	5.582	+0.06		—0.20
June	—15.48	5.944 (Differences.)	+0.11		—1.67
July	—15.73	5.918	+0.12		+0.51
August	—14.06	5.504	+0.09		+1.66
September	—10.47	4.701 (—1.191)	+0.02		+0.06
October	— 4.91	3.510 (—1.191)	—0.11		—0.02
November	—10.47	2.319	+0.02		+0.04
Correct. to tabular t_m =	+ 0.14				

These differences between the observed and computed values are very nearly within the probable uncertainty as given in a preceding table.

For the winter season, the most simple interpolation seems to be the best that can be adopted. We find for December 1st the temperature —26°.5, the mean of the temperatures for November 15th and December 15th, and for March 1st, in like manner; the mean temperature —30°.0. The following table[1] was used for interpolation:—

Mean temperature Dec. 1st		—26°.5	
"	Jan. 15th	—28.2	$\Delta = 1°.7$
"	March 1st	—30.0	1.8

[1] For the purpose of a ready comparison and uniformity of method, the following expression of the annual variation of the temperature at Van Rensselaer Harbor is here inserted; it compares directly with similar expressions for other stations given by Kämtz and inserted in the article (Sir John Herschel's)

Influence of Winds on Temperature.—To ascertain the temperature of the winds, the following method was employed. By means of the preceding formula, expressing the temperature, a set of tables was formed—partly by direct computation, partly by interpolation between these computed values—of the daily mean temperature throughout the year, and the same was set down opposite the respective hours of the day when the mean temperature is reached. Next, by means of the known diurnal variation, interpolated from its mean monthly value, for each day, these tables were completed by inserting the temperature for every hour of the day to the nearest whole degree. They were then compared, hour for hour, with the abstract of observed temperature, and the difference $\left\{\begin{matrix}+\text{ for excess}\\-\text{ for defect}\end{matrix}\right\}$ placed in the column for the respective wind as observed at the same hour. For this latter purpose, an hourly abstract of the wind was prepared. The abstract of differences contains eight columns for each of the principal directions, and an additional one for calms. By this process, the effect of the annual and diurnal variation is at once eliminated, and the remaining differences can safely be left to their own compensation. The results for the months from September to January (both inclusive, have been combined for the two years. The following table exhibits the results of this somewhat lengthy process. The first column contains the magnetic directions of the wind, including a line for the calms; the second, the sum of the differences as explained above; the third, the number of times the wind blew from each of the eight directions during the seventeen months of registered hourly temperatures and winds; the sum total, or Σn, equals 11534, and the number by which it falls short of 12264, indicates the number of hours observations were wanting; the last figure in the column gives the number of hours during which the atmosphere was calm. The fourth column shows the values of $\frac{\Sigma\,\Delta}{n}$, or the quantity by which each wind affected the temperature, the sign + corresponding to an effect of raising the temperature above its mean.

"Meteorology," Vol. XIV. 8th edition of the *Encyclopædia Britannica.* The value $\theta = 0$ corresponds to January 1st and T is expressed in degrees of Fahrenheit's scale.

$$T = -2°.20 + 35°.39\ sin\ (\theta + 251°\ 43') + 6°.72\ sin\ (2\,\theta + 69°\ 47') + 3°.20\ sin\ (3\,\theta + 17°\ 5').$$

The formula leaves the following differences (0.—C.) between the observed and computed monthly means:—

In January	−0°.2	In July	+1°.2
February	+3.4	August	+1.5
March	−4.9	September	−2.4
April	+2.7	October	+1.4
May	+0.3	November	+1.3
June	−2.5	December	−1.9

And a probable error of any single determination of ± 1°.6. The warmest day is accordingly July 8th, and the coldest March 1st. The mean temperature of the year is attained April 29th and October 12th. The mean diurnal variation for the whole year, as derived from its monthly values, is represented by the formula—

$$t = +1°.85\ sin\ (\theta + 64°\ 55') + 0°.08\ sin\ (2\,\theta + 97°) + 0°.03\ sin\ (3\,\theta + 128°),$$

with a probable error for any single hour of ± 0°.03, the angle θ counting from noon.

Mag. direction of wind.	$\Sigma\Delta$	n	$\frac{\Sigma\Delta}{n}$	Mag. direction of wind.	$\Sigma\Delta$	n	$\frac{\Sigma\Delta}{n}$
N.	+ 34	323	+0°.1	S. W.	+ 2729	955	+2°.9
N. E.	+ 138	92	+1.5	W.	+ 509	313	+1.6
E.	+ 220	159	+1.4	N. W.	+ 99	744	+0.1
S. E.	+2879	1182	+2.4	C.	—22923 .	6655	—3.4
S.	+2346	1111	+2.1				

These results are necessarily imperfect, on account of the impossibility of obtaining a correct mean temperature from so short a series of observations, yet their ratio may be depended upon. We notice that all winds tend to elevate the temperature, and the calms to lower the same. The frequency of the calms is greater than that of all the winds combined. The difference in the temperature of the warmest and coldest wind is 2°.8; N. E., E., and W. (magnetic) winds show a mean value; S. E., S., and S. W. winds are from 0°.6 to 1°.4 above, and N. and N. W. winds 1°.4 below, this mean temperature. The region included by the directions S. E. and S. W. (magnetic), or N. N. E. and E. S. E. (true),[1] being the quarter of the warmer winds, and the space between W. S. W. and S. S. W. (true) that of the colder winds. It must be remarked that, since a true north wind the longer it blows assumes a more and more easterly direction, the true directions between N. N. E. and E. point to a more northerly origin of the wind than actually indicated.[2]

Of the rise of temperature during certain gales, the explanatory foot-notes in the temperature abstract may be referred to; the more remarkable cases are the following ones:—

Gale of	November 28, 1853,	from the	S. E. (a little snow falling).
"	December 10, "	"	S. E. (not snowing).
"	December 28, "	"	S. E. and S. W. (no snow).
"	February 7, 1854,	"	S. (no snow).
"	May 7–8, "	"	S'd "
"	November 20, "	"	S. W. "
"	December 18, "	"	S. E. "
"	January 29, 1855,	"	S. E. "
"	February 13–14, 1855,	"	S. E. "

The reader may also be referred to pp. 17, 30, 39, 40, and 55, of the 2d vol. of the Narrative.

Effect of Snow (and Rain) on the Temperature.—If we combine in like manner the differences of observed and mean temperature of all hours during which snow fell, we find a great regularity in the monthly values expressing the elevation of temperature during the hours of the fall of snow, due to the conversion of latent into sensible heat. The following table exhibits in the first column the algebraic

---

[1] See my discussion of Dr. Kane's magnetical observations, in Vol. X. of the Smithsonian Contributions to Knowledge, 1858. The magnetic declination is found 108° west.

[2] The bearing of this investigation on an open (partially so) polar sea, can only be fully made out after the construction of a hygrometric and barometric wind-card. The direction of the warmer winds points towards the Spitzbergen Sea, and the relative colder winds come in a direction from the northernmost part of continental America.

sum of the above differences for the hours during which snow fell, the second column the number of hours, and the last column the rise of temperature above the mean. In 17 months, it snowed during 680 hours, and rained during 60 hours. This small quantity of rain fell in the month of July; snow also fell during 10 hours in this (warmest) month.

	$\Sigma\Delta$	n			$\Sigma\Delta$	n	
2 January . . .	+1403°	74	+19°.0	July	+ 50°	70	+ 0°.7
February . . .	+ 250	16	+15.6	August	+ 54	26	+ 2.1
March	+ 130	14	+ 9.3	2 September . .	+ 419	111	+ 3.8
April	+ 176	21	+ 8.4	2 October . . .	+ 623	80	+ 7.8
May	+ 534	136	+ 4.0	2 November . . .	+1323	79	+16.7
June	— 48	36	— 1.3	2 December . . .	+ 819	77	+10.6

On the average, during the whole year, the sensible heat was increased during the fall of snow by 7°.7.

The bearing of this source of change of the temperature on the alternation of relative cold and warm periods during the winter season, will be further illustrated in the following analyses of these undulations.

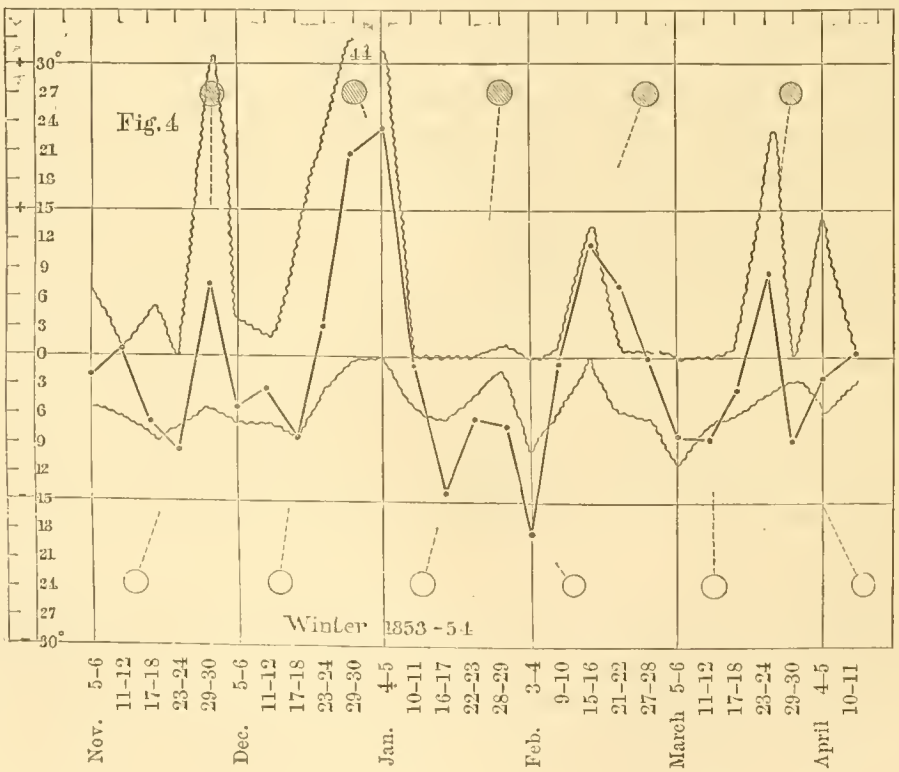
Recurrence of Maxima of Cold during Winter.—An alternate variation from comparatively warmer to colder extremes, taking weeks to perform their cycles, has before been noticed in the arctic regions of America. These returns of maxima of cold, their causes, periods, and amplitudes, now deserve our particular attention. Dr. Kane, from various notes in his log-book, seems to be inclined to consider the phases of the moon as intimately connected with the subject; on page 55, Vol. II. of the Narrative, he remarks: "There is a seeming connection between the increasing cold and the increasing moonlight." Under date Nov. 28th, 1854, he entered the following remark in the log: "The moon first appeared above the hills to S. and S. E. The depression of the temperature, and the general transparency of the atmosphere, is again noted as material for discussion." Dec. 1st, 1854, he says: "With the cessation of wind, the absence of cirri, and the increased brightness of the moon, the atmosphere grows sensibly colder. * * * This immediate influence of the moon is a matter of frequent observation. The full moon season, with cloudless nights is always in correspondence with the lowest mean temperatures of our meteorological record." The following discussion has been made in accordance with these notes.

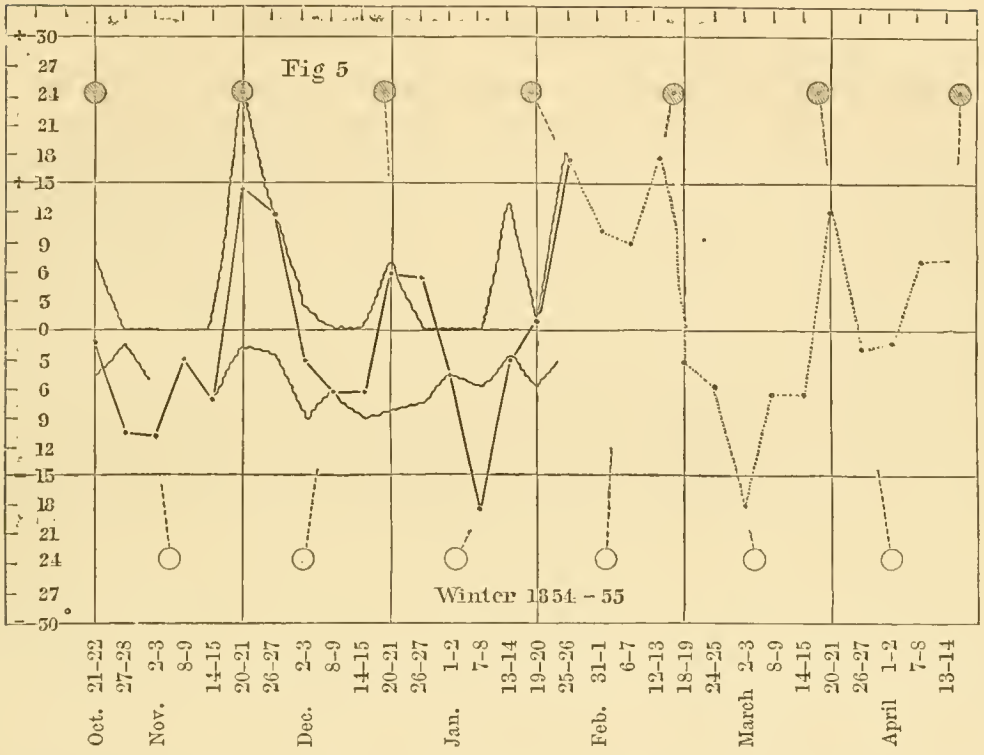
To eliminate as much as possible disturbing influences, particularly those produced by the winds and precipitations, the average of the mean daily temperature of a number of consecutive days has been taken, and it was found, after trials with 3, 5, 6, and 7 days, that the period of 6 days answered best, that is, brought out in the plainest manner, the march of the temperature during the winter season, the general features of the curves being the same for any of the above periods.

The epoch of the 6 day period was so selected that the highest and lowest temperatures should, as near as may be, fall towards the middle of a period. These average values were next compared with the mean temperature deduced from the half monthly means in order to exhibit the deviation of the observed average values

above or below the mean temperature, $\pm$ indicating $\left\{\begin{matrix}\text{warmer}\\\text{colder}\end{matrix}\right\}$ than the mean. These differences are herewith presented graphically by full lines; the phases of the moon are marked opposite the corresponding dates, the new moons being given at the top, the full moons at the bottom, of each diagram. The investigation commences with Nov. 3d, and ends with April 13th, for the winter 1853–54, and includes the time between Oct. 19th and April 16th of the second winter. Between these intervals, the mean half monthly temperatures are below —10°. Temperatures observed after Jan. 24th, 1855, have been taken from the abstract in Vol. II. of the Narrative (corrected for index error). They are probably subject to small corrections, and hence have been dotted in the diagram.

The wavy line above the zero line indicates the number of hours during which snow fell in the corresponding 6 day period; the numbers in the vertical column answering also for the hour scale. The wavy line below, or on the negative side of the temperatures, indicates the number of clear days in each 6 day period, and in order to use the side figures also for this day-scale, the number of clear days was doubled, 12 being the maximum indication of 6 clear days.





These diagrams fully bear out the observer's remarks, viz: that the lowest temperatures are reached about the time of full moon. Setting aside some small deviations in the regularity of the curves (of temperature), there is not a single exception to the correspondence of relative maxima of cold near the epoch of the full moon, and of relative minima of cold near the time of new moon. The period between any two consecutive maxima of cold from five intervals is $25^{d}.2 \pm 1^{d}.9$, and the same between the minima of cold from four intervals $28^{d}.5 \pm 2^{d}.4$, for the first winter, and $28^{d}.8 \pm 1^{d}.5$ (from five intervals), and $28^{d}.8 \pm 3^{d}.3$ (from five intervals), for the second winter, respectively. Combining these four values with the application of weights according to the respective probable errors, the resulting period for the recurrence of cold becomes $27^{d}.7 \pm 1^{d}.0$. The synodic period of the moon is $29^{d}.5$; somewhat longer than the period just deduced, but by no means incompatible therewith.

If we now follow the curve indicating the duration of the fall of snow, we find, in the two winters, maxima near the period of new moon, thus accounting, in conformity with the previous investigation, for the rise in the temperature; the average elevation above the mean temperature for the six winter months, during the hours of snow fall, being, according to the table, 13°. The superior maximum of Dec. 27th to Jan. 1st (first winter), when it snowed during 44 hours, is particularly instructive.

The lower wavy line indicates maxima in the amount of serenity of atmosphere near the time of full moon, better marked in the first than in the second winter. The above special case of Dec. 29–30, is again interesting as conspiring to an ele-

vation of temperature by the nearly total obscurity of the atmosphere during the six days in question.

The mean amplitude of the wave in the winter 1853–54 is 19°.4, and in the winter 1854–55, 20°.1, or 19°.8 from an average during these two winters.

It has been remarked by an eminent astronomer that, if the moon emits any sensible heat, it is probably expended and becomes apparent by a tendency to disappearance of clouds under the full moon. Supposing this to be a fact, it would seem that the powerful radiating force of the earth's surface, called into activity under a clear sky, produces, as a secondary effect, the phenomenon of greatest cold at the time of full moon. The process is going on gradually, and, when combined with the tendency of a fall of snow about the period of new moon, would favor the production of the caloric waves observed during the winter season. These waves could not be explained either in range, duration, or regularity, by the effect of various winds and calms, since their total effect could only amount in maxima to 6½°, according to the previous investigation.

A maximum cold will be produced, as stated by Dr. Kane, by a concurrence of the time of full moon with a perfect calm and a great transparency of the atmosphere, during the middle of the winter season. The opposite effect requires, for its full development, a concurrence of the time of new moon with a continued fall of snow, a generally obscured atmosphere, and winds from a direction between N. N. E. and E. S. E. (true).

Enough has been shown to make these alternations of relative cold and warm periods in winter an interesting and instructive subject for further study, specially with a view of tracing out and confirming the apparent connection of the concurrence of the two principal lunar phases, with a tendency to obscurity and transparency of the atmosphere.

In accordance with Prof. Dove's investigations of the return of cold about the 11th of May, the mean daily temperature on May 13th (1854) of +2°.8 was 9°.3 lower than the computed (by preceding formula) temperature.[1]

Hourly Corrections for Periodic Variations.—The following table for reducing the mean of observations taken at any hour of the day to the true mean temperature of the day, has a similar arrangement, and was prepared for the same use, as those given for other stations in the Smithsonian *Miscellaneous Collections of Meteorological and Physical Tables*, by Prof. A. Guyot (2d edition, Washington, 1858). The figures necessarily present some anomalies, since they are derived directly from a series of hourly observations extending over seventeen months; they present, therefore, only the differences between the hourly and the true means.

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[1] While this paper was going through the press, I received the March number (1859) of the *London, Edinburgh, and Dublin Philosophical Magazine*, containing J. Park Harrison's article on the "Lunar Influence on Temperature as connected with Serenity of the Sky." He states that, from 20 years of observations at Greenwich, the mean temperature is above the average at the period of the new moon (also at first quarter and before last quarter), it is below the average before and after full moon (also between new moon and first quarter, and at and after last quarter).

ARCTIC AMERICA—VAN RENSSELAER HARBOR, Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Corrections to be applied to any hourly or set of hourly observations to obtain the mean temperature of the day. Degrees of Fahrenheit.

Hours.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1 A. M.	+0.07*	+1.65	+1.97	+4.50	+4.45	+3.11	+1.54	+2.60	+2.22	−0.12	−0.68	+0.37	+1.81
2	+0.31	+1.61	+1.79	+4.51	+4.11	+3.06	+1.45	+2.29	+2.20	−0.07	−0.61	+0.22	+1.74
3	+0.44	+1.44	+1.98	+4.92	+3.45	+2 89	+1.42	+2.37	+1.92	−0.15	−0.68	+0.48	+1.71
4	+0.48	+0.84	+2.21	+4.39	+2.90	+2.56	+1.42	+1.99	+2.02	−0.22	−0.70	+0.66	+1.55
5	+0.47	+1.51	+2.14	+3.55	+1.60	+1.27	+1.26	+2.13	+2.03	−0.30	0.00	−0.18	+1.29
6	+0.49	+0.94	+1.91	+2.88	+0.71	+0.62	+0.60	+1.51	+1.44	−0.27	+0.27	−0.33	+0.90
7	+0.82	+0.51	+1.20	+1.83	−0.05	−0.24	+0.43	+0.87	+0.45	−0.42	+0.07	−0.17	+0.44
8	+0 23	+0.20	+0.79	+0.75	−0.99	−1.49	−0.24	−0.12	−0.97	−0.36	+0.23	−0.11	−0.17
9	+0.35	−0.03	−0.52	−0.93	−0.91	−0.71	−1.23	−1.22	−1.70	−0.66	+0.04	−0.45	−0.66
10	+0.09	−0.56	−1.09	−1.61	−1.60	−0.92	−1.44	−2.07	−2.35	−0.91	+0.18	−0.45	−1.07
11	−0.47	−0.23	−2.27	−2.58	−1.90	−1.29	−1.81	−2.72	−2.22	−0.79	−0.39	−0.60	−1.44
Noon	−0.95	−0.86	−2.82	−3.23	−2.44	−2.06	−1.85	−2.38	−2.96	−0.62	−0.58	−1.08	−1.83
1 P. M.	−0.67	−1.35	−3.20	−3.67	−2.67	−2.21	−1.64	−2.42	−3.00	−0.53	−0.20	−1.00	−1.88
2	−0.65	−1.35	−3.61	−4.49	−2.91	−2.09	−1.50	−2.43	−2.62	−0.35	−0.20	−0.68	−1.91
3	−0.15	−1.20	−2.97	−4.62	−3.01	−1.79	−1.46	−2.02	−2.13	−0.44	−0.12	−0.34	−1.69
4	−0.10*	−1.11	−1.88	−4.32	−3.30	−1.48	−1.46	−1.48	−1.57	−0.30	−0.01	−0.04	−1.42
5	−0.24	−0.85	−1.20	−4.20	−2.72	−1.29	−0.66	−1.19	−0.94	−0.03	−0.17	+0.07	−1.12
6	−0.24	−0.98	−0.57	−3.33	−1.89	−1.17	−0.32	−0.68	−0.47	+0.36	+0.09	+0.22	−0.75
7	−0.34	−1.03	−0.05	−1.93	−1.04	−0.67	−0.05	−0.29	+0.34	+0.87	+0.25	+0.78	−0.26
8	−0.07	−0.88	+0.83	−0.96	−0.18	−0.44	+0.52	+0.07	+0.86	+0.98	+0.35	+0.72	+0.15
9	−0.16	−0.45	+0.96	+0.36	+0.65	+0.21	+0.95	+0.37	+1.20	+0.98	+0.86	+0.61	+0.55
10	−0.24	+0.62	+1.21	+1.90	+1.76	+0.64	+1.52	+1.02	+1.63	+1.06	+0.54	+0.53	+1.02
11	+0.40	+0.66	+1.45	+2.64	+2.80	+1.55	+1.36	+1.40	+2.37	+1.04	+0.79	+0.44	+1.41
Midn't	+0.08	+0.94	+1.62	+3.76	+3.24	+1.94	+1.25	+1.98	+2.70	+1.11	+0.65	+0.27	+1.63
6, 6	+0.12	−0.02	+0.67	−0.22	−0.59	−0.27	+0.14	+0.44	+0.48	+0.04	+0.18	−0.05	+0.08
7, 7	+0.24	−0.26	+0.57	−0.05	−0.54	−0.45	+0.19	+0.29	+0.40	+0.22	+0.16	+0.31	+0.09
8, 8	+0.08	−0.34	+0.81	−0.11	−0.58	−0.96	+0.14	−0.02	−0.05	+0.31	+0.29	+0.30	−0.01
9, 9	+0.10	−0.24	+0.22	−0.28	−0.13	−0.25	−0.14	−0.42	−0.25	+0.16	+0.45	+0.08	−0.06
10, 10	−0.07	+0.03	+0.06	+0.15	+0.08	−0.14	+0.04	−0.52	−0.36	+0.07	+0.36	+0.04	−0.02
7, 2, 9	0.00	−0.43	−0.48	−0.77	−0.77	−0.71	−0.04	−0.40	−0.32	+0.07	+0.24	−0.08	−0.31
6, 2, 10	−0.13	+0.07	−0.16	+0.10	−0.15	−0.28	+0.21	+0.03	+0.15	+0.15	+0.20	−0.16	0.00
7, 2, 9, 9	−0.04	−0.43	−0.12	−0.49	−0.41	−0.48	+0.21	−0.20	+0.06	+0.30	+0.40	+0.09	−0.09
3, 9, 3, 9	+0.12	−0.06	−0.14	−0.07	+0.05	+0.15	−0.08	−0.12	−0.18	−0.07	+0.03	+0.08	−0.02

* The tabular quantities for 1 A. M. and 4 P. M., in January, are mean values of the directly observed values for these hours combined with those of the preceding and following hours.

The hours 7 A. M., 2 P. M., and 9 P. M., are those of the Mannheim Meteorological Society, adopted at the military posts of the United States and by the Smithsonian Institution; the hours 3 and 9 A. M. and 3 and 9 P. M., are those proposed by the Royal Society. Of the bi-hourly series, the observations at 10 A. M. and 10 P. M., will give a very close approximation; the sum of the squares of the tabular monthly values is a maximum, and the temperature at these hours does not change as rapidly as at other hours. Of the three-hour series, the hours 7, 2, and twice 9 are most convenient, but less accurate than the hours 6, 2, 10. The hours 3 and 9 A. M. and P. M., have the least sum of the squares of the monthly values; these hours are most suitable for cases having a sufficient number of observers, or for fully organized expeditions.

Solar Radiation.—After the return of light in the spring of 1854, a thermometer was exposed to the direct action of the sun. On and after April 10th, the statical measure by means of a black bulb thermometer was adopted. In connection with these observations, the estimated amount of solar light was also noted. From a

note, Oct. 19th, 1854, it appears that the numbers expressive of the quantity of solar light have the following signification:—

1 Entirely clear.
2 Slightly obscured.
3 Clouded.
4 Misty and dark.
5 Excessive obscurity.

The sign 0, which occasionally occurs, probably indicates either no observation, or snowy or rainy atmosphere. There are a few apparent anomalies in the following tables, the temperature indicated by the black bulb being somewhat lower than that indicated by the shade thermometer with an overcast sky. These may arise from a slightly erroneous index error, or occasional observing errors, or different localities of exposure.

The following record of the observations of the temperature by the black bulb thermometer exposed to the solar rays, contains the corrected readings, which renders them directly comparable with the readings of the preceding general record, and has been inserted for the use of those who may desire to further investigate the subject.

READINGS OF THE BLACK BULB THERMOMETER, AND CORRESPONDING NOTES ON THE SOLAR LIGHT, OBSERVED AT VAN RENSSELAER HARBOR,

In April, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorologieal observatory.

Hour.	10th.	11th.	12th.	13th.	14th.	15th.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	...	...	...	...	...	...	...	...	—10.0	...	...	— 8.0	— 8.0	...	...
4	...	...	...	...	...	...	...	...	...	— 1.0	...	+ 4.0	— 1.0	...	+1.0
5	...	— 7.0	—17.0	...	...	— 5.0	...	0.0	—10.0	+ 9.0	— 4.0	+ 2.0	+ 5.0	...	2.0
6	...	— 6 0	—10.0	...	...	— 4.5	+ 7.0	+ 5.0	— 2.0	+10.0	0.0	+12.0	+14.0	...	3.0
7	— 4.0	+ 5.0	— 6.0	...	...	— 4.5	16.0	4.0	+ 2.0	+ 8.0	+ 8.0	?	+ 7.0	+ 8.0	7.0
8	— 4.0	+10.0	— 2.0	...	...	+ 2.0	12.0	4.0	+ 5.0	+ 4.0	+12.0	?	+16.0	7.6	8.0
9	— 2.0	+ 6.0	*+1.0	+ 6.2	...	+ 4.5	12.0	6.0	+10.0	+ 5.5	+ 8.0	+20.0	+22.0	13.0	15.0
10	+ 0.5	+10.0	+ 1.0	6.0	...	+ 6.0	12.0	8.0	+11.0	+14.0	+14.0	+17.0	+13.5	13.0	15.0
11	+ 1.0	†+10.0	+ 2.0	12.0	+6.0	+ 9.0	‡15.0	8.0	+ 6.0	+17.5	+ 9.0	+ 4.0	+24.0	16.0	19.5
Noon	+ 2.0	+ 4.0	+ 2.3	10.0	+6.0	+10.0	?	...	+14.0	+24.0	+25.0	+18.0	+17.0	21.0	27.0
13	+ 1.8	+ 1.8	+ 5.0	12.0	...	+10.0	25.0	26.0	+ 8.0	+12.0	+16.0	+26.0	+27.0	20.0	23.0
14	— 0.6	+ 2.0	+ 7.0	10.0	+5.0	+ 6.0	25.0	24.0	+18.0	+15.0	+25.0	+18.0	+30.0	23.0	24.0
15	— 1.5	+ 3.5	+ 8.0	9.0	+4.5	+ 3.0	20.0	22.0	+10.0	+18.0	+22.0	+17.0	+33.0	30.0	20.0
16	— 2.0	+ 5.0	+ 7.0	+ 8.0	+5.0	+ 3.3	20.5	20.0	+ 9.0	+15.0	+20.0	+15.0	+28.0	21.0	14.0
17	— 2.5	— 8.0	— 1.0	...	+5.0	...	16.0	8.0	?	+15.0	+17.0	+14.2	+22.0	14.0	9.5
18	§—7.5	—11.0	— 1.9	...	+4.5	...	14.0	6.0	— 2.0	+ 8.0	+ 7.0	+14.0	+ 9.0	13.0	2.0
19	—10.0	—18.0	— 3.6	...	+4.0	...	+ 5.0	4.0	— 3.0	+ 3.0	+ 4.0	+11.0	+ 8.0	6.5	+3.0
20	— 9.0	—20.5	...	...	+2.0	...	0.0	+ 4.0	— 4.0	— 4.8	+ 3.0	+ 9.0	+ 2.0	3.0	...
21	...	...	...	...	—1.5	...	...	...	...	— 5.2	— 4.0	— 3.2	...	+ 1.8	...
22	...	...	...	...	...	...	...	...	...	?	— 4.5	— 3.0	...	0.0	...
23	...	...	...	...	...	...	...	...	...	?	...	...	...	...	...
Midn't	...	...	...	...	...	...	...	...	...	—13.9	...	...	...	...	...

Hour.	10th.	11th.	12th.	13th.	14th.	15th.	16th.	17th	18th.	19th.	20th.	21st.	22d.	23d.	24th.
1h.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
2	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1
3	...	...	...	...	...	...	...	...	...	...	...	1	1	...	1
4	...	...	...	...	...	...	...	...	...	1	...	1	1	...	1
5	3	3	1	...	...	1	...	1	1	1	1	1	1	...	1
6	3	4	1	...	4	1	3	1	1	1	1	1	1	...	1
7	3	4	1	...	...	1	2	1	1	1	1	1	1	4	1
8	3	4	1	...	...	1	1	1	1	1	1	1	1	?	1
9	4	1	1	4	‖4	1	...	...	1	1	1	1	2	2	1
10	4	1	1	4	‖4	1	...	...	1	1	1	1	1	2	1
11	4	2	1	4	4	2	...	...	1	1	1	1	2	2	1
Noon	4	2	1	4	4	2	...	...	1	1	1	1	2	2	1
13	4	2	1	4	‖4	2	1	1	1	1	1	1	2	1	1
14	4	2	1	4	4	2	1	1	1	1	1	1	2	1	1
15	4	2	1	4	4	4	1	1	1	1	1	1	2	1	1
16	4	2	2	4	4	‖4	1	1	1	1	1	1	2	1	1
17	4	1	2	4	4	‖4	1	1	1	1	1	1	3	1	1
18	4	1	3	4	4	‖4	1	1	1	1	...	1	3	2	1
19	4	1	3	...	4	‖4	1	1	1	2	...	1	4	1	1
20	4	1	4	...	4	‖4	1	1	1	3	...	1	4	1	1
21	...	...	...	...	4	...	...	...	...	3	...	...	...	...	1
22	...	...	...	...	...	...	...	...	...	3	...	...	...	...	1
23	...	...	...	...	...	...	...	...	...	3	...	...	...	...	1
Midn't	...	...	...	...	...	...	...	...	...	4	...	...	...	...	1

* Corrected from 10° to 1°.0.

† In the original, it has the sign —.

‡ Changed from 5 to 15.

§ Corrected reading, the original being 9°.

‖ The original has 0; the column for clouds indicates 4, as above.

NOTE.—The observations are made with mercurial thermometer No. 1; by comparison with the observatory standard at +42°, its correction was —0°.1. It was not thought necessary to apply this small correction.

READINGS OF THE BLACK BULB THERMOMETER, AND CORRESPONDING NOTES ON THE SOLAR LIGHT, OBSERVED AT VAN RENSSELAER HARBOR,

In April and May, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory.

Hour.	25th.	26th.	27th.	28th.	29th.	30th.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	...	...	...	+ 4.0	...	...	...	...	...	*—6.5	+ 2.1	...	...	+ 6.3	...
2	...	— 1.0	...	4.0	...	...	...	...	...	*—6.0	3.5	...	...	9.8	+14.0
3	+ 3.0	+ 1.0	— 3.8	3.0	+ 5.0	+ 7.0	+ 9.0	...	+ 1.0	*—4.5	5.0	+ 0.5	+ 7.5	9.7	17.0
4	4.0	4.0	+ 4.2	3.0	7.0	8.0	12.0	...	12.0	*—4.0	6.5	1.0	10.5	11.3	20.0
5	6.0	5.0	5.0	4.3	8.0	8.3	14.5	...	17.0	+ 2.0	7.0	6.0	10.0	16.0	22.0
6	7.5	7.0	5.6	5.5	10.0	8.0	24.0	...	18.0	+ 2.0	8.0	8.0	10.0	18.0	26.5
7	8.0	12.0	5.9	6.0	12.0	13.0	21.5	...	21.0	+ 1.5	8.0	14.0	13.0	20.0	26.0
8	11.0	16.0	6.8	8.5	13.0	14.0	29.0	...	19.0	+ 1.0	9.0	14.0	20.0	20.0	21.0
9	6.0	20.0	10.0	10.0	15.0	15.0	26.0	...	16.0	+ 5.0	10.0	10.0	26.0	18.0	16.0
10	8.0	25.0	12.0	16.0	16.0	25.0	28.0	...	20.0	+10.0	10.5	14.5	21.0	19.0	17.0
11	10.0	26.0	15.0	17.0	16.0	23.0	28.0	...	27.0	+16.0	11.0	20.1	18.0	23.0	28.0
Noon	12.0	30.0	18.0	20.0	16.0	22.0	19.0	...	32.0	+18.0	11.2	20.0	20.0	26.0	30.0
13	12.5	32.0	23.0	22.0	18.0	20.0	22.0	...	30.0	+19.0	11.5	17.5	16.0	27.0	28.0
14	12.0	28.0	24.0	24.0	22.0	21.0	29.0	...	27.0	+16.4	13.0	16.0	13.0	30.0	29.0
15	15.0	26.0	22.5	22.0	20.0	20.0	24.0	...	22.0	+13.0	11.5	12.4	13.0	29.0	30.0
16	18.0	25.0	22.0	14.0	18.0	22.5	20.0	...	21.0	+ 9.2	12.0	11.0	15.0	28.0	32.0
17	13.0	22.0	23.0	13.0	15.0	22.0	17.0	...	18.0	+ 9.0	13.0	7.0	13.0	25.0	30.0
18	8.0	20.0	20.0	12.0	15.0	11.0	14.0	...	14.5	+ 7.5	12.0	6.0	14.3	24.0	26.0
19	7.0	18.0	17.0	8.0	13.0	9.0	+10.0	...	+ 6.0	+ 5.0	10.0	5.0	13.0	22.0	27.0
20	+ 7.5	15.0	12.0	8.0	11.0	8.0	...	...	0.0	+ 2.0	+ 6.0	4.0	14.0	21.5	24.0
21	...	+ 8.0	+ 8.0	6.0	10.0	5.0	...	...	— 5.0	+ 1.5	— 1.0	3.8	11.5	16.0	13.0
22	...	...	0.0	+ 4.0	+ 9.0	+ 1.0	...	...	...	— 1.0	...	3.0	11.0	14.0	12.5
23	...	...	...	...	...	...	...	...	...	...	...	+ 2.8	+10.0	8.0	10.2
Midn't	...	...	...	...	...	...	...	...	...	...	...	...	...	+ 7.0	+11.0

Hour.	25th.	26th.	27th.	28th.	29th.	30th.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.
1h.	...	1	1	1	1	1	1	...	1	1	4	3	3	2	1
2	...	1	1	1	1	1	1	...	1	1	4	3	3	2	1
3	1	1	1	1	1	1	1	...	1	1	4	2	4	2	1
4	1	1	1	1	1	1	1	...	1	1	4	2	3	1	1
5	1	1	1	1	1	1	1	...	1	1	4	1	3	2	1
6	1	1	1	1	1	1	1	...	1	1	4	1	4	3	1
7	1	1	1	1	1	1	1	...	1	1	4	1	3	3	1
8	1	1	1	1	1	1	1	...	1	1	4	1	3	3	1
9	1	1	1	1	1	1	1	...	1	1	4	2	2	3	1
10	1	1	1	1	1	1	2	...	1	1	4	1	4	3	1
11	1	1	1	1	1	1	3	...	1	1	3	1	4	3	1
Noon	1	1	1	1	1	1	3	...	1	1	3	1	4	1	1
13	1	1	1	1	1	1	1	...	1	1	3	1	†4	2	1
14	1	1	1	1	1	1	1	4	1	1	3	2	†4	1	1
15	1	1	1	1	1	1	2	4	1	1	3	2	2	1	1
16	1	1	1	1	1	1	2	3	1	1	3	2	1	2	1
17	1	1	1	1	1	1	2	3	1	1	3	2	1	1	1
18	1	1	1	1	1	1	2	3	2	1	2	2	1	1	1
19	1	1	1	1	1	1	3	1	2	1	2	3	1	1	1
20	1	1	1	1	1	1	4	1	2	2	3	3	1	1	1
21	...	1	1	1	1	1	4	1	2	2	3	3	2	1	1
22	...	1	1	1	1	2	...	1	2	3	3	4	2	1	1
23	...	1	1	...	1	2	...	1	2	...	4	3	2	1	1
Midn't	...	1	1	...	1	2	...	1	1	...	4	4	2	1	1

* The sign is wanting in the original.

† Zeros in the abstracts.

On May 2d, the sun was obscured during the greater part of the day.

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In May, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory.

Hour.	10th.	11th.	12th.	13th.	14th.	15th.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+14.0	+ 5.0	+ 5.0	+ 6.0	+ 6.0	+ 9.0	+15.0	+14.0	...	+10.0	+13.0	+12.0	+11.0	+19.0	+17.0
2	15.0	7.6	4.0	7.0	7.0	10.0	20.5	13.0	...	12.0	16.5	13.5	12.0	17.0	18.0
3	18.0	7.7	2.0	10.8	12.0	9.0	23.0	15.0	...	13.0	23.2	14.8	16.0	22.0	26.0
4	20.0	8.0	5.0	13.0	14.0	13.0	20.0	15.0	...	14.0	27.0	16.0	22.0	20.0	26.0
5	23.0	6.2	8.0	14.0	17.0	13.0	18.0	16.0	...	20.0	30.2	17.0	28.0	21.0	36.0
6	23.2	7.0	9.6	14.5	18.5	18.0	20.0	16.5	...	30.0	38.0	20.0	30.0	24.0	21.0
7	22.8	9.0	11.0	16.0	22.2	20.0	21.0	18.0	...	36.0	36.0	28.0	40.0	28.0	28.0
8	23.0	11.5	13.2	16.8	23.8	24.0	22.0	19.5	...	39.0	35.0	30.0	34.0	32.0	38.0
9	23.0	13.5	15.0	18.0	29.0	17.0	30.3	21.0	...	31.0	27.0	28.0	27.5	27.0	32.1
10	20.0	17.5	20.0	20.0	31.5	20.0	28.0	24.0	...	34.0	29.5	30.0	34.0	34.0	32.0
11	15.0	20.0	26.0	27.0	31.0	22.5	34.0	31.0	...	33.0	30.0	30.0	39.0	31.5	35.0
Noon	11.5	25.0	32.0	24.0	30.2	24.0	40.0	40.0	...	38.6	30.5	30.0	48.0	34.0	31.0
13	13.0	26.0	34.0	22.0	32.0	25.5	36.0	36.0	...	43.1	32.0	30.0	40.0	31.0	32.5
14	11.5	28.0	38.0	24.0	31.0	26.0	29.0	23.0	...	46.0	38.0	29.0	44.0	29.0	35.0
15	13.2	24.0	34.0	24.0	31.5	28.5	27.0	23.5	...	40.0	36.0	31.0	43.0	24.0	39.4
16	13.1	18.0	20.0	22.0	29.0	29.0	23.0	25.0	...	30.7	37.0	27.0	35.0	23.0	34.0
17	12.0	14.0	21.0	21.0	29.0	27.0	24.5	24.0	...	29.0	33.0	24.0	31.5	25.0	39.0
18	11.0	13.5	17.0	17.0	30.4	25.0	23.5	17.5	...	23.0	32.0	23.0	29.5	28.0	29.0
19	9.0	12.3	12.0	14.5	25.0	22.0	22.0	+13.0	...	20.0	31.2	19.0	27.0	27.0	27.0
20	10.0	10.0	8.3	10.0	14.5	18.0	20.0	...	...	17.0	29.0	17.5	24.0	27.0	28.0
21	10.0	9.0	10.5	8.0	18.0	12.0	17.0	...	+10.0	15.0	20.0	16.2	21.0	18.0	+23.0
22	10.4	8.0	11.0	7.0	12.0	11.0	16.0	...	9.0	12.0	17.5	11.0	19.5	16.0	...
23	+ 9.0	7.0	13.0	3.0	14.0	10.5	14.5	...	8.0	9.0	17.0	11.0	18.0	18.0	...
Midn't	...	+ 8.0	+ 9.0	+ 2.0	+ 8.0	+ 8.0	+12.0	...	+ 9.0	+ 8.0	+13.4	+10.0	+14.0	+16.0	...

Hour.	10th.	11th.	12th.	13th.	14th.	15th.	16th.	17th.	18th.	19th.	20th	21st.	22d.	23d.	24th.
1h.	1	*4	1	2	1	1	1	1	*4	2	1	2	1	1	2
2	1	*4	1	1	1	1	1	2	*4	2	1	2	1	1	2
3	1	*4	1	1	1	1	1	2	...	2	1	2	1	1	1
4	1	*4	1	1	1	1	1	2	...	2	1	2	1	1	1
5	2	4	1	1	1	1	1	2	...	2	1	2	1	1	2
6	2	4	1	1	1	1	1	2	...	1	1	2	1	1	3
7	3	4	1	1	1	1	1	2	...	1	1	2	1	1	2
8	3	3	1	1	1	2	1	2	...	1	1	2	1	1	1
9	3	3	1	1	1	2	1	2	...	2	1	2	1	1	1
10	4	4	1	1	1	1	1	2	*4	2	1	1	1	1	1
11	*4	4	1	1	1	1	1	2	4	4	1	1	1	2	1
Noon	*4	4	1	1	1	1	1	2	4	3	1	1	1	3	1
13	4	3	1	1	1	1	1	1	4	2	1	1	1	4	1
14	4	2	1	1	1	1	1	1	4	2	1	2	1	4	1
15	4	2	1	1	1	1	1	2	4	1	1	2	1	4	1
16	4	3	1	1	1	1	1	3	4	1	1	1	1	3	1
17	4	3	1	1	1	1	1	3	4	1	1	1	1	2	1
18	4	2	3	1	1	1	1	3	4	1	1	2	1	1	1
19	4	3	3	1	1	1	1	*4	4	1	1	2	1	1	1
20	4	3	4	1	1	1	1	*4	4	1	1	3	1	1	2
21	4	2	4	1	1	1	1	*4	3	1	1	2	1	1	3
22	4	1	4	1	1	1	1	*4	3	1	1	2	1	1	...
23	4	1	4	1	1	1	1	*4	3	1	1	1	1	1	...
Midn't	4	1	4	1	1	1	1	4	3	1	1	1	1	1	...

* The original has 0s.

May 14th. McGary returned, reporting open water at Fog Inlet as far as the eye could see across the channel.

May 20th. The sun is now acquiring power in the middle of the day sufficient to soften the snow on the surface, and black objects lying upon it sink quite fast.

READINGS OF THE BLACK BULB THERMOMETER, AND CORRESPONDING NOTES ON THE SOLAR LIGHT, OBSERVED AT VAN RENSSELAER HARBOR,

In May and June, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorologieal observatory.

Hour.	25th.	28th.	29th.	30th.	31st.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	...	+37.0	...	+31.0	+30.0	+25.0	+32.0	+30.0	+27.0	+28.0	+20.0	+23.0	+25.0	+26.0	+26.0
2	...	38.0	...	31.0	35.0	28.0	31.0	34.5	28.0	25.0	19.5	23.5	23.0	26.0	32.0
3	...	36.0	...	31.0	33.0	25.0	32.0	38.7	28.0	26.2	21.0	28.0	33.0	26.0	33.0
4	+20.5	37.5	...	32.0	31.0	32.0	33.0	42.0	28.0	28.0	22.0	34.0	35.0	26.0	38.0
5	...	...	...	32.0	30.0	32.0	38.0	...	...	32.0	24.0	38.3	36.0	27.5	36.0
6	...	...	...	36.0	32.0	26.4	40.0	...	...	31.6	24.0	29.1	37.3	28.3	37.0
7	...	...	...	40.0	36.0	29.0	50.0	...	...	31.3	30.0	30.0	38.0	29.2	38.0
8	...	45.0	+46.0	45.0	37.0	34.0	45.0	...	...	29.5	32.0	32.5	39.5	31.7	38.0
9	28.0	42.0	44.0	42.0	35.0	39.0	42.0	44.0	35.0	35.1	34.0	34.0	40.0	33.2	35.0
10	31.0	41.0	...	44.0	36.0	37.0	38.5	38.0	36.0	38.0	35.0	38.0	40.0	34.0	41.0
11	27.0	43.0	...	40.0	37.0	38.0	38.0	42.0	37.0	34.0	32.0	40.0	44.0	35.0	40.0
Noon	33.0	40.0	...	43.0	36.0	42.0	37.0	40.0	38.0	34.0	33.0	34.0	42.0	36.0	41.0
13	32.0	41.0	40.0	43.5	42.0	38.0	34.0	37.0	33.7	36.0	36.0	38.0	42.0	35.0	41.3
14	33.0	42.0	42.0	42.0	41.0	39.0	34.5	37.0	34.5	36.0	38.0	44.0	38.0	42.5	42.0
15	34.0	41.3	38.0	39.4	40.0	37.5	34.5	36.0	35.0	36.2	36.0	44.0	34.0	46.0	44.0
16	32.0	41.0	42.0	39.0	40.0	38.0	34.0	33.0	34.0	37.2	31.5	35.0	34.0	36.0	43.5
17	31.0	...	40.0	36.0	39.0	38.0	34.0	32.5	31.0	35.0	32.0	35.0	34.0	36.0	44.0
18	30.0	...	40.0	35.0	39.0	38.0	34.0	31.7	30.0	30.0	28.2	35.0	34.0	35.5	45.0
19	30.5	...	39.0	34.5	36.0	38.0	34.5	34.5	29.0	29.0	30.0	38.0	31.0	34.0	32.0
20	30.6	...	38.0	31.0	37.0	35.0	34.0	31.5	30.0	28.0	26.0	37.0	+30.0	28.0	31.0
21	30.0	...	31.0	30.0	37.0	34.0	33.0	28.0	30.0	26.0	28.0	36.0	...	34.0	29.0
22	29.0	...	30.5	26.0	34.0	34.0	32.0	28.0	29.0	29.0	27.0	30.0	...	30.0	28.0
23	25.0	...	+30.0	27.0	32.0	28.0	30.0	28.0	29.0	28.0	25.0	31.0	...	30.0	28.0
Midn't	+26.0	...	...	+25.0	+29.0	+27.5	+29.0	+28.0	+28.0	+24.0	+23.0	+24.0	...	+28.0	+27.0

Hour.	25th.	28th.	29th.	30th.	31st.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.
1h.	...	4	...	4	2	1	2	...	...	4	4	4	1	4	1
2	...	4	...	4	2	2	2	...	...	4	4	4	...	4	1
3	...	4	...	4	1	2	2	...	...	4	2	3	...	4	1
4	4	4	...	4	1	1	2	...	...	4	2	1	...	4	1
5	...	...	...	*4	1	1	1	...	...	...	...	...	...	...	...
6	...	...	...	4	1	1	1	...	...	...	...	...	...	...	...
7	...	...	...	3	1	2	1	...	...	...	...	...	...	...	...
8	...	4	2	3	1	2	2	...	...	...	...	...	...	...	...
9	4	4	4	2	1	2	2	1	...	...	3	1	...	...	...
10	4	4	*4	3	1	2	3	1	...	1	4	1	3	4	2
11	4	4	*4	3	1	3	3	1	...	4	2	2	3	4	2
Noon	4	4	*4	3	1	3	4	1	1	4	2	3	1	3	2
13	4	4	4	3	2	3	*4	1	1	4	3	1	1	...	2
14	4	4	3	3	2	3	*4	1	1	4	...	1	...	3	2
15	4	4	4	3	2	3	*4	1	1	1	3	1	2	3	2
16	4	4	*4	3	1	3	*4	1	...	1	4	...	2	2	2
17	4	...	*4	3	1	3	*4	1	...	1	4	...	2	2	2
18	4	...	*4	*4	1	2	*4	1	...	1	4	...	2	1	2
19	4	...	*4	*4	1	1	3	1	...	...	...	...	...	...	1
20	4	...	*4	4	1	1	3	*4	...	...	...	...	...	...	1
21	4	...	4	4	1	1	3	3	...	...	...	...	...	...	...
22	4	...	4	3	1	1	2	3	...	...	...	...	...	...	...
23	4	...	4	3	1	1	1	3	...	...	...	...	...	...	...
Midn't	4	...	4	2	1	1	1	4	...	...	...	...	...	...	...

* Zeros in the original.

No observations on the 26th and 27th.

May 26th. The effect of the higher temperature is very apparent on the snow and ice, rendering the former very soft, and the latter spongy and porous.

May 27th. The snow is melting fast, the water rising through the cracks in the ice foot, and forming large basins every tide.

May 28th. Ice foot decaying rapidly.

READINGS OF THE BLACK BULB THERMOMETER, AND CORRESPONDING NOTES ON THE SOLAR LIGHT, OBSERVED AT VAN RENSSELAER HARBOR,

In June, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory.

Hour.	11th.	12th.	13th.	14th.	15th.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+28.0	+23.5	+25.0	+28.0	+40.0	+41.0	+33.0	+38.0	+33.0	+34.0	+31.0	+31.0	+31.5	+31.0	+34.0
2	27.0	25.0	25.0	30.0	43.5	29.0	34.0	36.0	33.0	36.0	31.5	31.0	31.5	34.0	33.0
3	27.0	25.0	24.0	30.0	48.0	28.0	34.0	36.0	33.5	36.0	33.0	31.0	31.5	33.0	33.0
4	30.0	25.0	24.0	29.5	35.0	28.0	40.5	42.0	33.5	37.0	33.6	30.0	31.5	37.3	34.0
5	32.1	28.0	29.0	34.0	...	36.0	40.4	39.0	40.0	38.0	33.6	38.1	28.0	38.0	39.0
6	32.2	29.7	29.0	34.8	...	34.5	40.1	38.8	42.1	34.3	34.0	35.7	29.5	39.7	40.0
7	32.0	30.6	29.8	33.4	?26.7	34.3	40.0	38.5	46.0	32.0	34.6	36.2	30.0	40.0	41.3
8	36.0	37.0	30.0	36.0	34.0	32.0	38.0	38.0	49.0	34.0	34.8	38.7	33.1	42.3	42.0
9	38.0	40.0	30.0	39.0	38.0	38.0	40.0	44.0	50.0	34.0	34.0	44.3	34.0	40.2	43.0
10	41.0	41.0	32.0	40.0	40.0	44.0	42.0	45.0	53.0	34.0	34.0	37.2	34.0	42.1	45.0
11	40.0	40.5	33.0	45.0	46.0	48.0	39.0	46.0	54.0	34.0	35.0	38.0	35.0	44.2	45.0
Noon	40.5	41.0	33.0	48.0	45.0	44.0	42.0	49.0	50.0	40.0	52.0	38.2	37.0	46.2	45.0
13	40.0	41.0	32.5	48.0	48.0	43.0	41.0	49.0	48.0	40.0	54.0	44.0	36.0	45.0	43.0
14	41.0	41.5	33.0	48.7	47.0	38.0	38.0	46.0	49.0	34.0	52.0	37.0	40.0	44.0	40.0
15	41.0	41.0	34.0	49.0	45.0	39.0	39.0	45.5	49.0	29.0	52.0	37.0	43.0	42.0	40.0
16	40.0	41.0	33.0	48.0	45.0	39.0	39.5	43.0	44.0	29.0	56.0	37.5	46.0	41.0	37.5
17	40.0	41.0	33.0	46.0	46.0	39.0	40.0	38.0	43.0	30.0	56.0	35.0	46.0	41.0	34.0
18	40.5	41.0	33.0	44.0	49.0	39.0	40.0	38.0	42.0	31.0	42.0	35.0	45.0	40.0	35.0
19	38.0	31.0	33.0	41.0	41.0	36.0	47.0	38.0	42.0	30.9	38.0	34.0	38.0	38.0	35.0
20	36.0	32.0	29.0	38.0	40.0	35.0	46.0	39.0	38.0	31.0	36.2	33.0	36.0	38.0	35.0
21	35.0	*32.0	29.0	38.0	41.0	34.0	44.0	38.0	38.0	31.0	33.5	33.0	31.0	37.0	34.5
22	34.0	26.0	29.0	38.0	40.0	32.0	40.0	34.5	40.0	32.0	?31.4	33.0	32.0	36.0	33.5
23	32.0	25.0	30.0	36.0	34.0	33.0	38.0	34.0	34.0	30.2	32.0	+32.0	33.0	35.0	34.0
Midn't	+33.0	+28.0	+31.0	+31.0	+40.0	+33.0	+38.0	+34.0	+34.0	+29.7	+32.0	...	+32.0	+35.0	+34.0

Hour.	11th.	12th.	13th.	14th.	15th.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.
1h.	4	4	3	1	1	1	2	1	4	1	4	4	4	2	3
2	4	4	2	1	1	3	2	1	4	1	4	4	4	2	3
3	...	3	3	1	1	4	2	1	4	1	4	4	4	2	3
4	...	3	4	1	1	4	1	1	4	1	4	4	4	...	2
5	4	3	2	1	1	3	1	1	4	1	4	4	4	...	2
6	4	2	2	1	1	2	1	1	4	1	4	4	4	...	2
7	3	2	2	1	1	2	1	1	4	1	4	4	4	...	2
8	4	2	2	1	1	2	...	1	3	1	4	4	4	...	2
9	2	2	3	1	1	2	...	2	1	1	...	4	1	3	1
10	2	2	3	1	1	2	...	2	1	1	...	...	1	3	1
11	2	3	3	1	1	1	2	2	1	1	...	...	1	3	2
Noon	2	4	3	1	1	2	1	2	1	2	1	...	1	3	2
13	2	4	2	1	1	2	1	2	1	2	1	...	4	2	2
14	2	4	3	1	1	2	1	2	1	4	1	4	4	3	1
15	2	4	3	1	1	2	1	2	1	4	2	4	4	2	2
16	2	4	3	1	1	2	1	2	1	4	3	4	2	2	2
17	1	4	3	1	1	2	1	4	1	4	4	4	1	3	2
18	1	4	3	1	1	2	1	4	1	4	4	4	1	3	...
19	...	...	4	1	1	2	1	4	1	4	4	4	2	3	3
20	...	...	4	1	1	3	1	4	1	4	4	4	2	3	3
21	...	...	4	1	1	3	1	4	1	4	4	4	2	3	3
22	...	...	4	1	1	3	1	4	1	4	4	4	2	3	3
23	...	...	4	1	1	3	1	4	1	4	4	4	2	3	3
Midn't	...	...	4	1	1	3	1	4	1	4	4	4	2	3	3

* Corrected from 23° to 32°.

READINGS OF THE BLACK BULB THERMOMETER, AND CORRESPONDING NOTES ON THE SOLAR LIGHT, OBSERVED AT VAN RENSSELAER HARBOR,

In June and July, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At meteorological observatory and Fern Rock Island.

Hour.	26th.	27th.	28th.	29th.	30th.	1st.	2d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+37.0	+36.5	+37.0	+38.0	+38.5	+36.0	+40.0	+50.0	+44.0	+45.0	+34.0	+37.0	+32.0	+36.0	+40.0
2	37.0	28.0	35.5	38.2	38.8	38.0	40.0	48.5	49.0	45.0	34.0	37.0	31.0	44.0	41.0
3	37.5	29.0	37.0	38.5	38.0	38.0	41.0	47.0	40.0	43.0	35.0	37.0	32.0	49.0	41.5
4	39.0	*47.0	37.0	40.0	39.0	38.0	41.0	48.0	48.0	43.0	34.0	36.0	36.0	44.0	49.5
5	39.0	37.0	35.0	45.2	40.0	39.0	...	53.0	45.0	44.0	34.0	...	36.0	39.0	50.0
6	39.0	39.0	35.1	45.2	46.0	39.5	...	66.0	47.0	41.0	35.0	...	37.0	40.0	49.0
7	39.0	38.0	35.1	45.0	48.0	38.0	...	56.0	50.0	45.0	36.0	...	38.0	46.0	52.0
8	40.0	41.0	36.2	45.0	51.0	38.0	...	67.0	53.0	44.0	36.5	...	38.5	44.0	51.0
9	39.5	43.0	38.0	46.0	50.0	40.0	...	61.0	60.0	46.5	37.0	38.0	38.0	44.0	49.0
10	39.5	44.0	39.0	46.0	52.0	41.0	...	54.0	64.0	?39.0	38.0	38.0	38.0	45.0	49.0
11	39.0	44.5	41.0	48.0	53.0	43.0	...	52.0	54.0	?39.0	39.0	38.0	40.0	43.0	47.0
Noon	44.0	46.0	41.5	49.0	53.0	43.0	...	49.0	49.0	40.0	37.5	39.0	41.0	43.0	46.0
13	54.0	49.0	44.0	51.0	53.0	48.0	...	49.0	48.0	40.0	37.0	?37.0	43.0	43.0	44.0
14	53.0	...	41.0	50.0	53.0	47.5	...	58.0	61.0	38.0	37.0	37.0	42.0	41.0	45.5
15	47.0	53.0	38.0	45.0	48.0	49.5	...	57.0	53.0	40.0	36.0	36.0	41.0	42.0	51.0
16	45.0	56.0	37.5	46.0	44.0	57.5	...	51.0	61.0	40.0	+34.0	37.0	39.0	41.0	47.0
17	45.0	51.0	37.3	42.0	43.0	54.0	...	51.0	†70.0	35.0	...	...	40.0	43.0	46.0
18	43.0	49.0	37.2	39.0	39.0	54.0	...	56.0	62.0	35.0	...	+53.0	44.0	44.0	41.0
19	41.0	50.0	34.5	39.5	37.5	46.0	...	59.0	57.0	36.0	...	...	42.0	42.0	40.0
20	40.0	49.0	34.5	38.0	35.5	?45.0	...	54.0	57.0	+35.0	...	...	42.0	42.0	39.0
21	41.0	49.0	34.0	38.5	35.0	40.5	...	51.0	50.0	...	...	...	41.0	38.0	+38.0
22	41.0	39.0	34.0	38.0	35.5	40.0	...	47.0	53.0	...	...	...	40.0	40.0	...
23	38.0	37.0	33.0	39.0	36.0	43.0	...	46.0	49.0	...	...	...	38.0	41.0	...
Midn't	+38.0	+37.0	+33.0	+38.0	+36.0	+37.0	...	+49.0	+43.0	...	...	...	+37.0	+42.0	...

Hour.	26th.	27th.	28th.	29th.	30th.	1st.	2d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.
1h.	2	4	3	2	2	3	2	4	4	2	?0	?0	?0	3	2
2	2	2	3	2	2	2	2	4	4	3	?0	?0	?0	1	2
3	2	2	3	2	2	2	2	4	4	2	?0	?0	?0	1	2
4	2	4	3	2	2	2	2	3	4	1	?0	?0	3	1	1
5	2	4	2	2	...	3	3	1	4	3	?0	?0	?0	1	1
6	2	4	2	2	...	4	4	1	4	3	?0	?0	?0	1	1
7	2	4	2	2	...	3	5	4	4	4	4	?0	3	1	1
8	2	4	2	2	...	3	5	1	4	4	4	?0	2	1	1
9	1	4	1	1	2	3	4	1	3	2	4	4	3	1	2
10	1	4	1	1	2	2	4	1	2	3	4	4	3	1	1
11	3	4	2	1	2	2	4	1	3	4	4	4	2	1	2
Noon	2	4	2	1	2	2	3	1	2	4	4	4	2	1	1
13	3	4	4	4	4	2	3	1	1	4	4	?0	3	1	1
14	3	...	4	4	4	1	3	2	1	4	4	?0	3	1	1
15	2	4	4	3	4	1	5	1	1	4	4	?0	2	1	1
16	2	4	4	...	3	2	5	2	1	4	4	?0	2	1	1
17	2	4	4	...	3	2	1	1	1	...	4	4	...	1	2
18	2	4	4	...	3	2	1	1	1	...	4	2	...	1	3
19	2	4	2	4	3	3	1	1	1	...	4	1	...	1	3
20	3	3	2	4	2	4	1	1	1	...	4	?0	...	1	4
21	3	3	3	4	2	2	2	4	?1	1	1	1	4	3	2
22	3	3	2	4	2	2	2	4	?1	1	1	1	4	2	?0
23	2	3	2	4	2	1	1	4	?1	1	1	1	3	1	?0
Midn't	4	3	2	4	2	1	1	4	?1	1	1	1	3	1	?0

* Probably 37°.0.

† Highest temperature observed.

June 26th. Thermometer No. 1 broke; mercurial thermometer No. 17 supplied its place. By comparison with the observatory standard, its index error is 1°.0, or its correction —1°.0, which has been applied.

July 1st. The ice, the past two days, has changed remarkably; the water streams from the hills commenced running yesterday, and the warm weather has caused large pools on the surface of the ice in the bay, covering it to the depth of several inches.

July 2d. Thermometer No. 17 broke at 9 A. M. Its place was supplied by No. 16; its correction, from comparison with observatory standard, is —1°.2, and, with Tagliabue's standard, —0°.7. The correction —1°.0 was applied in the table. The water in the streams is still increasing, and the snow disappearing fast from the hills.

July 3d. No observations. On the 3d and 4th, young ice forms under the effect of a clear sky.

July 5th and 7th. The streams from the hills increase.

READINGS OF THE BLACK BULB THERMOMETER, AND CORRESPONDING NOTES ON THE SOLAR LIGHT, OBSERVED AT VAN RENSSELAER HARBOR,

In July, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. At Fern Rock Island and on board the brig.

Hour.	12th.	13th.	14th.	15th.	16th.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+34.0	+37.0	+36.0	+38.0	...	+40.5	+55.0	+45.0	+42.0	...	+36.0	+37.5	...	+37.0	+39.0
2	34.0	38.0	37.5	36.5	...	40.0	53.0	43.0	44.0	...	37.5	39.0	...	37.0	40.0
3	34.0	38.0	35.0	36.0	...	40.5	51.0	43.0	44.0	...	36.2	39.0	...	36.0	41.0
4	37.0	38.0	35.5	38.0	...	41.3	53.0	43.0	45.0	...	35.0	39.0	...	38.0	42.0
5	37.0	37.5	36.0	38.0	+35.5	42.0	54.0	43.5	46.0	+38.0	41.0	?36.5	...	41.0	...
6	39.0	40.0	35.5	39.0	38.2	41.0	57.0	45.0	46.5	39.0	39.0	?37.0	...	46.2	...
7	40.0	40.0	36.6	38.5	39.5	41.0	64.0	45.0	47.0	42.0	43.3	?37.8	...	51.0	...
8	40.0	41.0	39.0	38.0	40.0	42.0	63.0	44.0	47.5	42.0	44.0	41.0	...	58.0	...
9	39.0	41.0	41.0	38.5	39.5	49.0	64.0	48.0	40.0	35.0	47.0	48.0	...	58.0	46.0
10	39.0	41.0	48.5	38.0	39.8	57.0	65.0	49.0	39.0	37.0	46.0	48.0	...	60.0	48.0
11	39.0	41.0	47.5	37.0	40.0	59.0	63.0	55.0	39.0	39.0	45.0	49.0	...	61.0	53.0
Noon	38.0	41.0	49.0	35.5	39.5	59.0	60.0	56.0	39.0	44.0	41.0	50.0	...	59.0	59.0
13	38.0	42.0	50.5	38.0	38.0	60.0	60.0	57.0	58.0	45.0	42.0	52.0	+44.0	57.0	59.0
14	39.0	43.0	52.0	36.0	37.0	59.0	60.0	56.6	59.0	45.3	41.0	54.0	47.0	54.0	59.0
15	41.0	42.0	52.0	36.0	35.0	58.0	62.0	55.0	57.0	44.5	39.0	54.0	46.0	49.0	54.0
16	41.0	43.0	51.0	35.0	+35.0	57.5	62.0	56.0	57.0	44.0	37.0	+50.0	46.0	42.0	42.0
17	40.0	...	50.0	?34.0	...	57.0	61.0	55.0	41.0	?41.0	38.0	...	44.5	43.0	40.0
18	39.0	...	...	36.0	...	56.0	60.0	55.0	39.0	43.0	38.0	...	43.0	46.0	39.0
19	39.0	38.5	...	36.0	...	55.5	59.0	50.0	38.5	43.0	38.0	...	44.0	46.0	38.0
20	+37.0	+37.0	...	36.0	...	56.0	58.0	46.0	38.0	42.0	37.0	...	43.0	47.0	42.0
21	...	...	41.0	38.0	...	55.0	57.5	40.0	39.0	38.5	37.6	...	38.0	47.0	41.0
22	...	...	38.7	36.0	...	56.0	58.0	41.4	38.0	37.0	37.9	...	37.0	43.0	41.0
23	...	...	38.5	35.0	...	57.0	59.0	41.5	37.5	37.0	38.3	...	44.0	41.0	39.0
Midn't	...	...	+37.0	+34.0	...	+57.0	+58.0	+43.0	+36.0	+37.0	+38.2	...	+42.0	+42.0	+36.0

Hour.	12th.	13th.	14th.	15th.	16th.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	...	4	1	4	...	...	...	4	?0	4	3	...	...	2	1
2	...	4	1	4	...	...	...	4	?0	4	3	...	...	2	1
3	...	4	...	4	...	...	...	3	?0	4	3	...	...	3	1
4	•...	4	...	4	...	...	...	3	2	4	3	...	...	3	1
5	4	4	...	4	3	...	...	3	2	*4	3	4	...	2	...
6	4	4	3	4	3	...	...	3	2	*4	2	4	...	1	...
7	4	4	3	4	4	4	1	3	2	*4	2	4	...	1	...
8	4	2	3	4	4	3	1	3	2	*4	1	4	...	1	...
9	4	2	3	4	4	2	1	3	4	4	2	*4	1	1	1
10	4	2	3	4	4	1	1	2	4	4	1	*4	1	1	1
11	4	2	3	4	4	1	1	2	4	4	2	*4	3	1	1
Noon	4	2	3	4	4	1	1	2	3	4	1	*4	3	1	1
13	3	4	2	4	4	1	1	4	1	3	4	*4	2	1	1
14	4	4	1	4	4	1	1	4	2	2	4	*4	2	1	1
15	4	4	2	4	3	1	1	4	2	1	4	*4	2	1	3
16	4	...	3	4	2	1	1	4	1	2	4	2	2	1	4
17	4	...	4	4	4	1	1	4	4	2	4	2	2	1	4
18	4	...	4	4	*4	1	1	4	4	?0	4	2	1	1	4
19	4	4	4	4	*4	1	2	4	4	?0	4	3	1	1	4
20	4	4	4	4	*4	1	3	4	4	?0	4	4	1	1	2
21	?0†	...	4	4	*4	1	3	4	3	3	4	4	2	1	3
22	?0	...	4	4	*4	1	2	4	3	3	4	4	2	1	4
23	?0	...	4	4	*4	1	2	4	2	4	4	4	2	1	4
Midn't	?0	...	4	4	*4	1	2	4	2	4	4	...	1	1	4

* Zeros in the original.

† These and other zeros are inserted by G. Riley, who had been on watch from 8 to 12 since the 5th inst.

July 17th, etc. No observations on the 17th, 18th, 19th, 20th, and 21st, of the black bulb temperatures.

July 28th. The two sun thermometers were taken from the island. At noon, July 29th, these thermometers were suspended on board the brig, 8 feet from deck.

July 31st. Messrs. Sonntag, Ohlsen, and Stevenson returned. They found the sound perfectly open to the southward of the north cape of Bedevilled Reach, and open leads extending to within 6 miles of the brig.

READINGS OF THE BLACK BULB THERMOMETER, AND CORRESPONDING NOTES ON THE SOLAR LIGHT, OBSERVED AT VAN RENSSELAER HARBOR,

In August, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. On board the brig.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	16th.	17th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+35.0	+31.0	+35.0	...	+38.0	+45.0	+42.0	+39.0	+39.0	+36.0	+43.0	+33.0	+32.0	+37.0	+33.0
2	35.0	31.5	35.5	...	37.0	43.0	42.0	39.0	42.0	37.0	41.0	36.0	32.5	30.0	32.5
3	35.0	31.0	35.0	...	36.0	39.0	40.0	37.0	43.0	36.0	41.0	37.0	44.0	31.0	35.0
4	36.0	31.0	36.0	...	37.0	43.0	40.5	35.0	47.0	36.3	42.0	38.0	50.0	31.0	39.0
5	36.6	33.0	37.0	+39.0	44.0	37.0	39.0	35.0	48.0	38.0	38.0	39.0	32.0	32.0	39.0
6	37.0	38.0	35.0	40.0	49.0	36.0	47.0	35.5	56.0	39.0	43.0	42.0	33.0	34.0	40.0
7	42.0	43.0	34.0	45.6	50.0	36.5	50.5	39.0	52.0	41.0	46.0	46.0	31.0	38.0	41.0
8	50.0	39.0	36.0	45.0	49.0	40.0	63.0	51.0	53.0	41.0	47.0	41.0	29.0	40.0	42.0
9	63.0	39.0	39.0	...	49.0	48.0	64.0	50.5	55.0	45.0	47.0	36.0	...	42.0	33.0
10	69.0	43.0	39.0	...	49.5	49.5	66.0	49.0	51.0	49.0	50.0	40.0	...	44.0	34.5
11	66.0	45.0	39.0	...	48.0	49.0	62.0	47.0	52.0	52.0	51.0	40.0	...	44.0	36.0
Noon	41.0	48.0	39.0	39.0	49.0	51.0	60.0	46.0	52.5	53.0	55.0	38.0	...	47.0	34.0
13	49.0	43.0	39.0	41.0	53.0	52.0	59.0	47.0	50.0	52.0	55.0	37.0	...	42.0	35.0
14	40.0	44.0	39.0	...	52.0	55.0	59.0	47.0	49.0	51.0	51.0	47.0	...	44.0	37.0
15	39.0	43.0	39.0	...	49.0	56.0	56.0	46.0	48.0	53.0	51.0	48.0	...	55.0	39.0
16	39.0	41.0	39.0	...	41.0	55.0	53.0	45.0	48.0	49.0	49.0	46.0	...	55.0	38.0
17	39.0	41.0	...	...	44.0	53.0	39.0	45.0	46.0	48.0	48.0	43.0	...	54.0	41.0
18	41.0	39.0	...	43.0	44.0	48.0	39.0	42.0	45.5	42.0	47.0	43.0	...	52.0	44.0
19	40.0	51.0	...	...	45.0	...	42.0	39.0	43.0	46.0	46.0	40.0	...	49.0	43.0
20	38.0	49.0	...	...	45.0	...	57.0	38.0	42.0	49.0	45.0	33.0	...	56.0	42.0
21	37.0	39.0	35.0	...	49.0	45.0	49.0	38.3	42.0	39.0	42.0	33.0	...	+42.0	33.0
22	32.0	35.0	35.0	...	48.0	45.0	41.0	36.0	41.0	39.0	42.5	34.0	...	...	33.0
23	31.0	33.5	36.0	...	47.0	44.0	39.0	36.0	39.0	39.0	42.0	34.5	30.0	...	32.0
Midn't	+28.5	+33.0	+37.0	+51.0	+49.0	+42.0	+39.0	+36.0	+37.0	+39.5	+40.5	+35.0	+33.0	...	+32.0

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	16th.	17th.
1h.	4	3	4	4	2	4	4	2	1	1	1	1	1	1	1
2	4	3	4	4	1	4	...	2	1	1	1	1	1	2	1
3	4	3	4	4	1	4	...	3	1	1	1	1	1	*1	1
4	4	3	4	4	1	4	...	3	1	1	1	1	1	1	1
5	4	3	4	3	1	4	1	3	1	1	1	1	1	1	2
6	4	3	4	3	1	2	1	3	1	1	1	1	4	2	2
7	3	2	4	3	1	2	1	3	1	2	1	2	4	2	1
8	2	3	3	2	1	1	1	2	1	2	1	3	4	1	1
9	1	4	4	4	1	1	1	3	1	2	1	3	*4	1	1
10	1	4	4	4	1	1	1	3	1	1	1	2	*4	1	1
11	1	3	4	4	1	1	1	3	1	1	1	1	*4	1	1
Noon	1	2	4	4	1	1	1	4	1	1	1	1	*4	2	2
13	2	2	4	4	1	1	1	3	1	...	1	2	...	4	1
14	4	2	4	4	1	1	1	2	1	...	1	1	...	4	1
15	4	2	4	4	1	1	1	1	1	...	1	1	...	4	1
16	4	3	4	4	1	1	1	1	1	...	1	1	...	4	1
17	4	3	4	4	1	1	2	...	1	...	...	1	*4	1	2
18	4	2	4	4	1	1	2	...	1	1	...	2	*4	1	3
19	4	1	4	4	1	1	2	...	1	1	...	3	*4	1	3
20	4	2	4	4	1	1	1	...	1	1	...	3	*4	1	3
21	4	3	2	4	1	1	1	...	1	1	...	3	*4	2	3
22	4	4	...	4	1	1	1	...	1	2	...	4	4	...	3
23	4	4	...	4	1	1	1	...	1	2	...	2	2	...	3
Midn't	4	4	...	1	1	1	1	...	1	2	...	1	2	...	3

* The original has zeros.

August 14th. At 4 A. M., black bulb +32°.0; solar light 2.

August 15th. At 11 and 12 P. M., black bulb +31°.0 and +30°.0; solar light 3 and 2.

August 17th. The young ice bears a man.

READINGS OF THE BLACK BULB THERMOMETER, AND CORRESPONDING NOTES ON THE SOLAR LIGHT, OBSERVED AT VAN RENSSELAER HARBOR,

In August and September, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Expressed in degrees of Fahrenheit's scale. On board the brig.

Hour.	18th.	21st.	23d.	24th.	28th.	29th.	31st.	1st.	4th.	5th.	6th.	7th.	8th.	10th.	11th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1h.	+41.0	...	+23.0	+19.0	...	...	...	...	...	...	...	...	...	...	...
2	...	...	...	21.0	...	...	...	...	...	...	...	...	...	...	...
3	...	...	...	29.0	...	...	...	...	...	...	...	...	...	...	...
4	36.0	...	...	31.0	...	...	...	...	...	...	...	...	...	...	...
5	40.0	...	...	23.0	...	+39.0	...	+18.0	...	+ 6.0	...	...	+11.5	...	...
6	41.0	...	...	23.0	...	39.0	...	18.5	...	9.0	...	...	11.0	+13.0	...
7	39.0	+36.0	...	27.0	...	38.0	+34.0	18.0	...	9.5	...	+10.0	16.0	...	+11.0
8	40.0	37.0	24.0	31.0	...	39.0	32.0	23.0	...	11.0	...	11.0	17.0	...	16.0
9	40.0	37.0	24.0	37.0	...	38.0	34.0	23.0	+19.0	16.0	+20.0	13.0	18.0	45.0	20.0
10	41.0	38.0	42.0	36.0	+41.0	37.0	35.0	31.0	21.0	18.0	21.0	17.0	29.0	57.0	23.0
11	42.0	31.5	41.0	34.0	42.0	?	30.0	34.0	28.0	21.0	25.0	24.0	31.0	31.0	23.0
Noon	48.0	41.0	46.0	37.0	40.0	35.0	30.0	...	33.0	20.0	28.0	29.0	19.0	33.0	26.0
13	43.0	38.0	43.0	...	38.0	...	30.0	...	31.0	22.0	33.0	30.0	+15.0	31.0	22.0
14	48.0	36.0	43.0	...	38.0	...	31.0	...	32.0	17.0	30.0	29.0	...	31.0	31.0
15	53.0	38.0	42.0	...	39.0	...	32.0	...	27.5	13.0	29.0	28.0	...	30.0	17.0
16	52.0	+41.0	41.0	...	45.0	...	31.0	...	26.5	+11.5	+26.0	+27.0	...	+27.0	+27.0
17	49.0	...	...	+33.0	36.0	...	30.0	24.0	25.0	...	...	...	...	...	...
18	47.0	...	39.0	...	39.0	...	...	22.0	21.0	...	...	...	...	...	...
19	39.0	...	37.0	...	37.0	...	...	19.0	19.0	...	...	...	...	...	...
20	38.5	...	35.0	...	+33.0	...	...	20.0	+17.0	...	...	...	...	...	...
21	+37.0	...	...	...	...	...	23.0	20.0	...	...	...	...	...	...	...
22	...	...	31.0	...	...	...	21.0	19.0	...	...	...	...	...	...	...
23	...	...	27.0	...	...	...	+20.0	+18.0	...	...	...	...	...	...	...
Midn't	...	...	+27.0	...	...	...	...	...	...	...	...	...	...	...	...

Hour.	18th.	21st.	23d.	24th.	28th.	29th.	31st.	1st.	4th.	5th.	6th.	7th.	8th.	10th.	11th.
1h.	1	*	3	1	...	...	...	...	...	...	...	...	...	...	...
2	...	*	*	1	...	...	5	...	...	...	...	...	...	...	...
3	...	*	*	1	...	1	4	...	...	...	...	...	...	...	...
4	1	*	*	1	...	1	3	...	...	...	...	...	...	...	...
5	1	*	*	1	...	1	?0	1	*	1	...	...	1	...	...
6	1	*	*	1	...	1	?0	1	*	1	...	...	1	1	...
7	1	1	2	1	...	2	1	1	*	1	...	1	1	?0	1
8	1	1	*	1	...	1	3	1	*	1	...	1	1	?0	1
9	1	...	*	2	1	4	2	1	3	1	...	1	1	1	1
10	2	...	1	2	1	4	2	1	3	1	...	1	1	1	1
11	2	...	1	*	1	4	2	1	1	1	...	1	1	1	1
Noon	2	1	1	1	1	4	2	1	1	1	...	1	1	1	1
13	1	1	1	*	1	4	2	...	1	1	...	1	1	1	1
14	1	1	1	*	1	3	2	...	1	1	...	1	3	1	1
15	1	1	1	*	2	4	2	...	1	1	...	1	3	1	1
16	1	1	1	*	2	2	2	...	1	1	...	1	3	1	1
17	1	*	...	4	...	*	2	...	1	1	2	...	3	1	1
18	2	*	2	*	...	*	...	3	1	1	2	...	3	1	1
19	1	*	2	*	...	*	...	...	1	1	2	...	3	1	...
20	1	*	2	*	...	*	...	...	1	1	2	...	1	1	...
21	1	*	1	*	2	*	1	...	...	...	...	...	...	...	...
22	4	*	1	*	2	*	3	...	...	...	...	...	...	...	...
23	4	*	1	*	?2	...	3	...	...	...	...	...	...	...	...
Midn't	4	*	2	*	?2	...	...	...	...	...	...	...	...	...	...

* Zero's in manuscript.

August 19th. The outside bergs no longer move either with tide or current. Black bulb at 9, 10, 11, 12 A. M., 31°, 32°, 36°, 34°; solar light, 4, 4, 3, 4.

August 20th. Black bulb at 3, 4, 5 P. M., 45°, 43°, 31°; solar light, 4, 4, 3.

August 22d. Black bulb at 10, 11, 12 A. M., 35°, 36°, 25°; solar light, 3, 2, 1.

August 24th. By calculation, the lower limb of the sun just grazes the horizon at the northern meridian.

August 25th. Black bulb at 5, 6, 7, 8 A. M., 28°, 28°.5, 28°.5, 30°; solar light, *.

August 25th, 26th, 27th, 30th, and September 2d, 3d, 9th. No observations.

READINGS OF THE BLACK BULB THERMOMETER AND CORRESPONDING NOTES ON THE SOLAR LIGHT—Continued and completed.

Sept. 12.	At 6^h., 7, 8, 9, 10, 11, 12, 1, 2, 3, 4, 5^h.:	B. B. +6°, 12, 18, 21, 23, 21, 19, 18, 16, 14, 13, 8°
		S. L. 3, . . , . . , 1, 1, 1, 1, 1, 1, 1, 1, 2
Sept. 13.	Same hours:	B. B. +2°, 7, 20, 33, 31, 31, 33, 34, 28, . . , 19, 16°
		S. L. 1, 1, 1, 1, 1, 1, 1, 1, 1, . . , 1, 1
Sept. 14 and 15.	No. observations.	
Sept. 16.	At 8 A. M., 1, 2, 3 P. M.:	B. B. +13°, 16, 17, 14°; S. L. 1, 1, 1, 1
Sept. 17.	At 1, 2, 4, 5 P. M.:	B. B. +19°, 16, 13, 9°; S. L. 1, 1, 1, 2
Sept. 18.	No observations.	
Sept. 19.	At 11 and 12 A. M.:	B. B. +11°, 13°; S. L. 1, 1
Sept. 20.	At 11 A. M. and 3 and 4 P. M.:	B. B. +9°, 45, 5°; S. L. 1, 3, 3
Sept. 21.	At 9, 10, 12 A. M.:	B. B. +8°, 11, 18°; S. L. 1, 1, 1
Sept. 22.	At 12, 1, 2 P. M.:	B. B. +20°, 16, 12°; S. L. 1, 2, 3
Sept. 23.	At 10, 11, 12 A. M.:	B. B. +2°, 6.5, 5°; S. L. 3, 1, 1
Sept. 24, 25, 26.	No observations.	
Sept. 27.	At 10, 11, 12 A. M.:	B. B. +13°, 13, 10°; S. L. 1, 1, 2
Sept. 28.	At 11 A. M.:	B. B. +13°; S. L. 2
Sept. 29, 30, Oct. 1, to 14.	No observations of the black bulb thermometer.	
Oct. 15.	At 11 and 12 A. M.:	B. B. —3°, —4°; S. L. 1, 1

The black bulb readings were discontinued on Oct. 18.

Decrease of Temperature with Elevation.—Readings of the temperature at the level of the sea, and at eighty feet elevation on the mast of the brig, were taken during the months of August, September, and October, 1853. These observations were made with the same thermometer at the upper and lower position. The following are the mean differences obtained from twelve observations (bi-hourly) a day for the months August, September, and October, in the two positions: —0°.14, —0°.67, and —0°.30, the minus sign indicating "colder above." We have, therefore, for an elevation of eighty feet, an average change of —0°.37 of temperature during these three months; or the elevation corresponding to a decrease of temperature of 1° Fahr. becomes 210 feet.

Surface Temperature of Sea Water.—The following table contains the mean monthly values, from hourly observations, of the temperature of the surface water in Van Rensselaer Harbor. On the 19th of October, 1854, an order was given to immerge the thermometer four feet below the surface. On the previous day, the water alongside gave at the surface 32°; at three feet deep, 30°.5. After November 27th, the readings remaining constant at +29°, the observations were discontinued.

1853	September	29°.1	1854	May	28°.9
	October	28.8		June	30.3
	November	28.7		July	32.3
	December	28.7		August	31.8
1854	January	28.7		September	31.3
	February	28.7		October	30.9
	March	28.7		November	29.0
	April	28.8		December	. .

The index error of thermometer is not known; it must be small.

For a preliminary project of the isothermal lines of Baffin's Bay and adjacent islands, constructed for each month of the year, the reader is referred to Appendix No. XIII. of the 2d Vol. of the Narrative.

APPENDIX.

(See note on preceding page 2.)

Extract from Appendix No. XI. 2d volume of the Narrative, p. 405, on the Determination of Temperatures.

* * * * Sir Edward Parry, and more recent Arctic voyagers, have shown that there is a difference, amounting sometimes to two degrees, between the temperatures adjacent to, and at a distance from, the vessel. This was abundantly confirmed by our experience. During the intense cold of our winters, the instruments became very impressible to artificial elevation of temperature. The approach of the observer, the use of the lantern, the neighborhood of articles taken from a heated apartment, &c. &c., were at once perceptible in our records.

Except in naval expeditions, Arctic temperatures, whether Asiatic or American, have been recorded with a limited number of instruments. The results of these must be received with extreme caution; for the differences which alcoholic thermometers exhibit, at temperatures below the freezing point of mercury, are so varying as to require a large number of comparisons, and upon many instruments, to determine their proper correction. It was not uncommon for thermometers which had given us correct and agreeing temperatures as low as —40°, to show at —60° differences of from fifteen to twenty degrees. Such, too, was the case with the well-constructed instruments of Sir James Ross at Leopold Harbor.

To give an example of this, I may refer to the record of six thermometers suspended near each other, as above described, and observed for purposes of comparison at noon February 5th, 1854.

—71°, —63°, —54°, —53°, —50°, and —50°.

All of these, at temperatures above —40°, agreed within 1°.8, and were selected as the most consistent of nearly thirty spirit thermometers.

At 9 A. M. of the same day, eleven similar thermometers gave, under like circumstances, a mean of 68°, the extreme readings being —56°.4 and —80°. For the purpose of obtaining the most probable temperature from these conflicting records, my first impulse was to reject the lowest (coldest) extremes, and take the mean of those which accorded best; but upon advising with our astronomer, Mr. Sonntag, I determined to take the mean of all without rejecting any, the view which he took being simply that those instruments which indicated the extremes in the low scale had never, in temperatures above —40°, shown any anomaly which deprived them of an equal claim to confidence with the rest, and that there was no reason, *à priori*, to consider the results which they gave as less probable than those shown by the others.

In a word, I adopted the views of Professor Airy, as published in the 95th number of the *American Astronomical Journal*. The causes which had produced the errors were mostly unknown, and the quantity to which these errors might amount was entirely so.

Our thermometers were made with great care by Tagliabue, of New York. But, independently of other mechanical sources of error, I am obliged to say that I do not regard the contraction of colored alcohol, at very low temperatures, as sufficiently investigated to enable us to arrive at the causes or the quantity of error. In most of the spirit thermometers, the uniform thickness of the tube was tested before leaving New York; and the freezing of carefully distilled mercury, which I had taken with me for the purpose, gave excellent determinations of absolute temperature.

But it may not be uninteresting to state that the freezing point of this metal varied between —38°.5 and —41°.5, and that its rate of contraction as a solid was so uniform that, in our long and excel-

lent 36 inch standards, it descended after freezing as low as —44°. This result is in accordance with that obtained by Sir Edward Belcher, whose experiments go even further than my own, the mercury having been observed by him to descend as low as 46° below zero.

I may mention the fact, as in some degree confirming the propriety of not excluding an eccentric result from the computation of means, that two or more instruments may agree well together and still differ considerably from the most probable temperatures. This was the case with two long spirit thermometers, which never, even at the lowest temperatures, showed differences amounting to one degree, but which, at —68°, varied 7°.7 from the mean of eleven others. The cause was in this instance easily explained. The two instruments were *fac-similes* of each other; any errors of division of the scale, or from the unequal contraction of the fluid, which was the same in both, and the same in quantity, and probably taken from the same preparation of spirits, were of course common to both. The error induced by the coloring matter of the fluid adhering in small particles to the sides of the tube became very marked at low temperatures. Our routine of daily observation was as follows: Two 36 inch register spirit thermometers were noted hourly, as well as a varying number of instruments of smaller size. For purposes of comparison, the long spirit thermometers and from five to twelve of the others, in selected groups, were generally read at the same time. The difference between the mean of these observations and the reading of any one instrument, gave the correction which was applied to that instrument in order to get the true or most probable temperature. * * * * * *

PART II.

DIRECTION AND FORCE OF THE WIND.

RECORD AND DISCUSSION OF THE DIRECTION AND FORCE OF THE WIND.

The observations of the direction and force of the wind at Van Rensselaer Harbor, North Greenland, extend over the same period as the other meteorological observations, viz: from September 1st, 1853, to May 1st, 1855. With few exceptions, these observations were made hourly, and their record available for discussion, extends to January 24th, 1855. Those taken after this date will be found recorded (three times a day) in Appendix No. XII. of the second volume of the Narrative of the Expedition.

No self-registering anemometric instrument was used. The direction of the wind is given uncorrected for magnetic variation of the needle, and was noted in reference to eight principal points of the compass. The course of the wind thus given refers to the lower or surface stratum of the atmosphere. The force of the wind has been estimated as near as possible according to a scale extending from 1 to 10; the former number indicating light airs, the latter a hurricane. Zero denotes a calm air. These figures, expressive of the relative force of the wind, are placed in front of the letters indicating the direction, as given by its initial letter, and their relation to the velocity and pressure of the wind is shown in the following table, used in the United States Coast Survey.[1]

Denomination of Wind.	Estimated No. of force.	Pressure in pounds per square foot.	Velocity in miles per hour.	Denomination of Wind.	Estimated No. of force.	Pressure in pounds per square foot.	Velocity in miles per hour.
Calm	0	0.000	0	Fresh gale . . .	6	7.9	40
Light air . . .	1	0.005	1	Strong gale . . .	7	12.0	50
Gentle breeze . .	2	0.08	4	Storm	8	18.0	60
Moderate breeze .	3	0.9	13	Tempest . . .	9	31.0	80
Fresh breeze . .	4	2.6	23	Hurricane . . .	10	49.0	100
Strong breeze . .	5	5.1	32				

The relation of the tabular numbers of pressure and velocity is according to Smeaton's table, and is practically the same as that following from D. Bernoulli's formula.[2] It may be questioned whether the upper limit (No. 10) of the above table has been reached among the few observations marked 10 in this latitude;

[1] The scale of winds adopted by the Smithsonian Institution does not materially differ from it; see directions on the blank forms furnished to observers. The Coast Survey table will be found p. 277 of the Superintendent's Annual Report of 1856.

[2] See art. Meteorology, in Encyclopædia Britannica, 8th edition.

and, since the force of the wind depends altogether on an estimation, I prefer, in the small number of cases in which the forces 9 and 10 occur, to adopt the numbers 70 and 80 as the corresponding velocity in miles per hour.[1]

In the following hourly abstract of the anemometric observations, the direction is indicated by the initial letter or letters of the compass point, and the force by a number preceding it, according to the scale given above. Any intermediate directions, dividing the compass into 16 points, have been placed alternately in the column of the preceding and following principal direction; thus two successive entries in the log-book of N. N. E., will be found noted in the abstract as N. E. and N. In this manner the mean directions have in all cases been preserved. These intermediate directions are of comparatively rare occurrence. In a few instances, particularly during the first ten days (of September), there is some doubt as to the true meaning of a blank in the log, all other meteorological observations being duly recorded, whether this indicates a calm or an omission of observation. In these cases, I have likewise left a blank in the record, if not otherwise guided by the abstract given in Appendix No. XII. of the Narrative. The first vertical column in the abstract contains the hour of mean local time. Horizontal dashes (- - -) in the body of the abstract indicate "no observation," and two inverted commas (") signify the same force and direction as for the hour immediately preceding. The fall of snow (and rain) is also noted.

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[1] Mr. Sonntag's views on this subject agree with mine; he thinks the forces rather over-estimated, produced by the greater sensation of cold.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In September, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.[1]

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	- - -	3 N.	3 N. W.	- - -	- - -	0	6 S. W.	2 N. W.	0	1 W.	2 W.	2 W.	0	0	1 E.
2	"	"	2 N. W.	"	"	"*	4 S. W.	"	"	"	"	"	"	"	"
3	"	"	1 N. W.	"	"	"*	3 S. W.	"	"	"	- - -	"	"	"	"
4	"	"	"	"	"*	"*	5 S. W.	3 N. E.	"	"	"	"	"	"	"
5	2 N. W.	3 N. W.*	- - -	"	"*	"	4 S. W.	1 N. E.	"	- - -	"	0	"	1 S. E.	2 E.
6	"	3 N.*	"	"	"	"	3 S. W.	"	"	"	"	2 S. E.	"	"	"
7	"	2 N. W.*	"	"	"	"	"	0	"	"	"	0	"	0	"
8	3 N. W.	2 N.	"	"	"	"	4 S. W.	1 N. W.	"	"	"	"	"	"*	"
9	4 N.	2 N. W.	"	"	"	1 S. W.	3 S. W.	0	4 N. W.	"	0	"	"	"*	"
10	"	1 N.	"	"	"	"	"	"	4 N.	"	"	"	"	"*	4 E.
11	"	1 N. W.	"	"	"	2 S. W.	2 S. W.	"	4 N. W.	"	1 W.	"	"	"*	3 E.
Noon	"	1 N.	"	"	"	"	"	"	3 N.	"	0	"	"	"*	2 E.
13	4 N. W.	5 N. W.	"	"	1 N. W.	"*	3 E.*	"	- - -	"	- - -	"	"	"	1 E.
14	"	"	"	"	"	"*	2 E.*	"	"	"	"	"	"	"	"
15	"	"	"	"	"	3 S. W.	"*	"	"	"	"	"	"	"	0
16	"	"	"	"	"	5 S. W.	1 E.	"	"	"	"	"	"	1 S.*	"
17	4 W.	4 N. W.	"	"*	"	6 S. W.	1 N. W.	"	"	"	"	"	"	1 N.*	2 N.
18	"	"	"	"*	0	"	0	"	"	"	"	"	"	"	"
19	"	4 N.	"	"	"	"	"	"	"	"	"	"	"	1 N. E.	"
20	"	3 N. W.	"	"	"	"	"	"	"	"	"	"	"	"	1 N.
21	4 N. W.	2 N.	"	"	"	"	"	"	2 W.	0	0	"	"	"	0
22	"	2 N. W.*	"	"	"	7 S. W.	"	"	2 S. W.	"	"	"	"	1 E.	"
23	"	2 N.	"*	"	"	"	"	"	3 W.	3 W.	"	4 N.	"	"	"
Midn't	3 N. W.	2 N. W.	"*	"	"	"	"	"	3 S.	4 W.	"	3 N.	"	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.
1h.	0	1 N. W.	1 S.	0	0	0	2 S.	3 S.†	0	1 S. W.	0	2 S. E.	2 S. E.	2 N.	0
2	"	"	"	"	"	"	1 S.	4 S.†	"	2 S. W.	"	"	"	"	"
3	"	"	"	1 W.	"	"	"	3 S.†	"	3 S. W.	"	"	3 S. E.	"	"
4	"	"	"	0	"	"	"	2 S.†	"	4 S. W.	"	1 S. E.	2 S. E.	"	"
5	1 N.	"	0	1 N. E.	"	1 S.	1 S. W.	2 S. W.	"	2 S. W.	1 S. W.	2 W.	2 S. W.	"	1 W.
6	"	1 W.	"	2 N. E.*	"	"	1 S.	"	1 S. W.	1 S. W.	"	3 W.	1 S. W.	"	"
7	1 N. E.	"	"	2 E.	"	"	"	"	"	"	"	"	- - -	"	"
8	2 N. E.	"	"	"	"	"	"	"	"	"	"	1 W.	"	"	1 S. W.
9	0	- - -	"	0	"	0	0	"	1 S. E.	1 S.	0	2 E.	1 N. W.‡	"	1 S. E.
10	"	"	"	"	"	"	"	3 S. W.	2 S. E.	"	"	2 N. E.†	"‡	"	"
11	"	"	"	"	"	"	"	2 S. W.	"	2 S.‡.	"	1 N. E.†	2 N. W.‡	"	1 E.
Noon	"	"	1 N. W.	"	"	"	"†	1 S. W.	"	1 S.‡	"	"†	2 W.	"	1 N. E.
13	"	0	0	"	"	"	1 S.†	"	1 S. W.	"	"	1 S. E.	3 N.	2 N. W.	"
14	"	"	"	"	"	"	"†	"	"	"	"	"	"	3 N. W.	1 S. E.
15	"	"	"	"	"	"	"†	"	"	"	"	"	"	2 N. W.	"
16	"	"	"	"	"	"	"‡	"	"	"	"	"	"	"	0
17	"	1 W.	"	"	"	2 S. W.	3 S. E.†	"*	0	0	1 S. E.	"	2 N.	0	1 S.
18	"	"	"	"	"	3 S. W.	2 S. E.	"*	"	"	"	"	3 N.	"	2 S. W.
19	"	0	"	"	"	"	"	"*	"	"	"	"	"	"	1 S. W.
20	"	"	"	"	"	4 S. W.	3 S. E.	"*	"	"	2 S. E.	3 S.	"‡	1 N.	"
21	"	"	"	"	2 N.	3 S. W.	3 S.	"*	"	1 S. W.	"	- - -	"	0	1 W.
22	"	"	"	"	4 N. W.	"	"	"*	"	"	"	"	2 N.	"	"
23	"	"	"	"	1 N.	"	- - -	"*	"	"	3 S. E.	"	1 S.	"	0
Midn't	"	"	"	"	0	"	3 S. W.	"	"	"	"	"	"	"	1 S.

[1] This longitude resulted from the discussion of the moon culminations.

* Light snow falling.

† Light snow falling occasionally. At 17h., light spiculæ of snow falling, having been preceded for three hours by a misty atmosphere.

‡ Very light snow falling.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In October, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0	2 S. E.	1 E.	4 S.	2 S.	3 S.	1 S. E.	3 N. W.	5 S. E.	1 S.	3 S. E.	0	1 S. W.	0	0
2	"	"*	0	5 S.	"	2 S.	"	4 N. W.	6 S. E.	3 W.	2 S. E.	"‡	2 S. W.	"	"
3	"	"	"	5 S. E.	"	"	2 S. E.	"	"	1 W.	"	"	1 S. W.	"	"
4	"	"	"	5 S.	3 S.	"	3 S. E.	5 N. W.	4 S. E	2 W.	1 S. E.	"	0	"	"
5	"	3 S.	1 S.	"	"	3 S.	2 S. E.	"	5 S. E.	2 S. E.	"	2 S. W.	1 S.	"	"
6	"	"	"	"	3 S. E.	"	"	"	1 S. E.	3 S. W.	"	"	"	1 S. E.	"
7	"	"	"	"	3 S.	"	"	"	"	2 S. E.	"	"	"	"	"
8	"	"	"	"	3 S. E.	"	"	"	"	"†	1 S. W.	1 S. W.	"‡	"	"
9	"	3 N.	1 S. E.	"	"	2 S. E.	"	3 N. W.	"	2 S.	0	1 S.	"‡	2 N. W.	"
10	"	"	"	5 S. E.	"	"	"	2 N. W.	"	"‡	"	0	"‡	1 N. W.	"
11	"	2 N.	"	"	2 S.	"	3 S. E.	2 N.	0	1 S.	"	"	"‡	0	"
Noon	"	"	"	4 S. E.	"	"	3 S.	2 N. W.	"	3 S. E.	1 S. E.	"	"‡	"	"
13	"	"	1 E.	3 S. E.	2 S.	3 S.	2 S.	1 N. W.	1 S. E.	2 S. E.	"	1 S. W.	"‡	"	"
14	"	1 N.	"	"	2 S. E.	3 S.W.*	"	1 N.	"	"	"	1 S.	"‡	"	"
15	"	"	"	"	2 S.	3 E.	"	1 N. W.	"	"	"	"	"	"	"
16	"	"	"	2 S. E.	2 S. E.	"	"	1 N.	"	"	"	1 S. W.	"	"	"
17	"	1 N. E.	"	"	2 S.	2 E.	4 S.	1 N. W.	"	3 S. E.	"	"	2 S. E.	1 S. E.‡	"
18	"	1 E.	"	"	2 S. E.	1 E.	5 S. E.	"	"	"	0	4 S. W.	"	"‡	"
19	"	"	2 S. E.*	3 S. E.	1 S.	"	4 S. E.	"	2 S. E.	"	"	1 S. W.	3 S. E.	"‡	"
20	2 S. E.	"	4 S. E.	"	1 S. E.	"	0	"	3 S. E.	"	"	0	"	"‡	"
21	- - -	"	4 S.	4 S.	4 S.	2 S. E.	4 N. W.	4 N. W.	0	1 S. E.	"	"	2 S. E.	1 S.	"
22	"	"	"	"	"	1 S. E.	0	6 N. W.	"	3 S. E.	"	"	"	"	"
23	"	"	"	"	3 S.	"	"	"	"	"	"	"	4 S. E.	"	"
Midn't	"	"	"	5 S. W.	"	"	"	"	"	"	"	"	1 S. E.	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	0	0	0	1 S. W.	3 S. W.	3 S.	1 S.	1 S.	1 S. E.‡	2 S. E.	0	0	1 S.	0	0	0
2	"	"	"	2 S. W.	2 S. W.	"	"	"	"‡	1 S. E.	"	"	2 S.	"	"	"
3	"	"	"	"	4 S.	1 S.	2 S.	0	"‡	2 S. E.	2 S. E.	"	3 S.	"	"	"
4	"	"‡	"	"	3 S.	2 S.	"	"	"‡	"	0	"	0	"	"	"
5	1 S.	"	"	"	6 S.	1 S.	- - -	"	"‡	"	"	"	"	"	"	"
6	"	"	"	1 S. W.	1 S.	"	"	1 S. E.	"‡	"	"	"	"	"	"	"
7	3 S.	"	"	"	"	"	"	2 S. E.	"‡	2 S.	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	"	1 S.	"	"	"	"	"	"
9	0	"‡	"	2 S. W.	"	0	2 S.	- - -	2 S.	2 S.	"	"	"	"	"	"
10	"	"‡	"	"	"	"	1 S.	3 S. E.	2 S. W.	"	"	"	"	"	"	"
11	"	1 S. E.‡	"	1 S. W.	2 S.	"	0	1 S. E.	3 S. W.	"	"	"	"	"	"	"
Noon	"	"	"	"	1 S.	"	"	- - -	6 S. W.	1 S.	"	"	"	"	"	"
13	"	1 S.	1 S. E.	"	"	"	1 S.	2 S.	5 S. W.	5 S. E.	1 S. E.	"	2 S.	"	"	1 S. E.
14	"	"	"	"	"	"	0	"	6 S. W.	2 S. E.	"	"	1 S.	"	"	"
15	"	"	"‡	"	- - -	"	"	3 S. E.	"	1 S. E.	2 S. E.	"	0	"	"	"
16	"	"	"‡	"	"	"	"	2 S. E.	5 S. W.	"	"	"	"	"	"	2 S. E.
17	"	"	3 S. E.	2 N. W.	4 S.	"	"	1 S. E.	1 S. W.	1 S.	3 S. E.	"	"	"	"	3 S. E.
18	"	0‡	1 S. E.‡	"	"	"	2 S. E.	"	3 S. W.	"	2 S. E.	"	"	"	"	1 S. E.
19	"	"‡	"‡	"	3 S.	"	1 S. E.	2 S. E.	"	1 S. E.	"	2 S. E.	"	"	"	"
20	"	"‡	"‡	1 N. W.	0	1 S.	"	1 S. E.§	"‡	"	1 S. E.	1 S. E.	"	"	"	"
21	"	"	2 S. E.‡	1 S. W.	"	"	"	"	0‡	0	0	0	"	"	"	0
22	"	"	"‡	3 S. W.	"	0	"	"	"‡	"	"	"	"	"	"	"
23	"	"	0	1 S. W.	"	"	"	"	"‡	"	"	"	"	"	"	"
Midn't	"	"	"	"	"	"	"	"	"‡	"	"	"	"	"	"	"

* Dark and threatening.

† Very light snow falling; wind squally and varying. At 3 o'clock P. M. clouds dispersing.

‡ Snowing.

§ Snowing slightly.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In November, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0	0	0	0	0	0	0	2 N. W.*	1 S. E.	1 S. E.	3 E.	3 S. E.	0	0	0
2	"	"	"	"	1 S. W.	"	"	"*	"	"	"	1 S. E.	"	"	"
3	"	"	"	"	"	"	"	3 N. W.*	"	2 S. E.	1 E.	0	"	"	"
4	"	"	"	"	- - -	"	"	1 N. W.*	2 S. E.	3 S. E.	"	"	"	"	"
5	"	"	"	"	1 W.	"	"	"*	0	2 S.	2 S. E.	"	"	"	1 S. W.
6	"	"	"	"	"	"	"	"*	"	1 S.	1 S. E.	1 S. E.	1 S. W.	"	"
7	"	"	"	"	"	"	"	1 S. E.*	"	"	"	2 S. E.	2 S. W.	"	0
8	"	"	"	"	"	"	"	2 S. E.	"	0	"	5 S.	"	"	"
9	"	"	"	"	0	"	1 E.	0	"	3 S. E.	1 N. W.	6 S.	1 W.	"	1 S. E.
10	"	"	"	"	"	"	0	"	"	"	2 S. E.	5 S.	1 S.	"	0
11	"	"	"	"	"	"	1 E.	"	1 S.	0	"	5 S. E.	1 S. E.	"	"
Noon	"	"	"	"	"	"	0	"	0	1 S. E.	3 S. E.	4 S. W.	"	"	1 S. E.
13	"	"	"	"	1 W.	"	"	"	"	2 S. E.	0	1 S.	0	"	0
14	"	"	"	"	"	"	"	"	"	1 S. E.	"	0	"	"	"
15	"	"	"	"	"	"	2 N. E.	"	"	"	"	"	1 S.	"	1 S. E.
16	"	"	"	"	1 S. W.	"	1 N. E.	"	"	"	"	"	0	"	0
17	"	"	"	"	1 W.	"	"	"	2 S. E.	"	1 S. E.*	2 S. W.	1 S. E.	1 S. E.	1 S. E.
18	"	"	"	"	"	"	"	"	3 S. E.	"	2 S. E.	1 S. W.	0	"	0
19	"	"	"	"	"	"	2 N. E.	"	2 S. E.	2 S. E.	"	"	"	"	"
20	"	"	"	"	"	"	"	"	"	3 S. E.	"	"	"	2 S. E.	1 S. E.
21	"	"	"	"	0	1 S. W.	3 N. W.	"	1 S. E.	0	1 S. E.	1 S. E.	"	0	"
22	"	"	"	"	"	"	"	"	"	"	2 S. E.	2 S. E.	1 S. E.	"	"
23	"	"	"	"	"	0	4 N. W.	"	3 S. E.	"	3 S. E.	3 S. E.	0	"	"
Midn't	"	"	"	"	"	"	3 N.	"	2 S. E.	1 E.	4 S. E.	4 S. E.	"	"	1 S. E.

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.
1h.	0	0	0	0	0	2 N. E.	0	0	0	0	0	1 S.	0	0*	1 S. W.*
2	"	"	"	"	"	"	1 S. E.	"	"	"	4 N.	0	2 S.	"*	2 S. E.*
3	"	"	"	1 S.	"	"	"	"	1 S. E.	"	1 N.	1 S.	1 S.	"*	"*
4	"	"	"	0	"	0	0	"	0	"	"	2 S.	"	"*	1 S. E.*
5	"	1 S. E.	2 S.	"	"	2 S.	"	"	"	"	0	1 S. E.	0	1 S. W.*	0*
6	"	2 S. E.	1 S.	"	"	"	"	"	"	"	"	"	"	2 S. W.*	"*
7	1 S. W.	1 S. E.	"	"	"	1 S.	"	"	"	1 S. E.	2 S. E.	0	1 S. E.	1 S. W.*	1 N. W.*
8	2 S. E.	2 S.	"	"	"	"	"	"	"	2 S. E.	1 S. E.	"	0	"*	0
9	0	0	0	"	"	0	"	"	"	"	1 S.	1 S.	3 S. E.†	1 S.*‡	1 S. E.
10	"	"	"	"	"	1 S.	"	"	"	5 S. E.	"	"	"	2 N. W.*	"*
11	"	"	1 E.	"	"	0	"	"	"	6 S. E.	0	"	2 S. E.	"	0*
Noon	"	1 S. E.	0	"	"	"	"	"	"	5 S. E.	"	"	3 S. E.	1 N. W.	1 S. E.*
13	"*	0	"	"	"	"	"	"	"	4 S. E.	1 S. E.	"	"	0	"*
14	"*	"	"	"	"	"	"	"	"	3 S. E.	2 S.	"	"	"	3 S. E.*
15	"*	"	"	"	"	"	"	"	"	2 S. E.	"	2 S.	2 S. E.	"	4 S. W.*
16	"*	"	"	"	"	"	"	"	"	"	"	1 S.	1 S. E.	"	1 S. W.*
17	1 S. E.*	1 S. E.	"	"	2 S.	"	"	"	"	"	1 S. E.	1 S. E.	0	2 S.	1 S. E.*
18	3 S. E.	2 S. E.	"	"	"	"	"	"	"	1 S. E.	0	1 E.	"	1 S.	1 E.*
19	2 S. E.	1 S. E.	"	"	0	"	"	"	"	2 S. E.	"	"	"	0	2 N. W.*
20	4 S. E.	2 S. E.	"	"	1 S.	"	"	"	"	3 S. E.	1 N.	0	"	"	2 S. W.*
21	0	5 S. E.	"	"	0	"	"	"	"	6 S. W.	2 S.	"	"	"	1 N. W.
22	1 S. E.	"	"	"	3 S. E.	"	"	"	"	"	1 S.	1 S.	"*	"	"
23	0	1 S. E.	"	"	1 S. E.	"	"	"	"	5 S. W.	"	"	"*	"	0
Midn't	"	"	"	"	0	"	"	"	"	4 S. W.	0	2 S. E.	"*	1 S. W.	"

* Snowing.

† "After 8 o'clock A. M., the wind, which had been previously from the S'd, set in from due S. E. The thermometer instantly rose 2°.1, and by 6 P. M. gave us the extraordinary temperature of —5°.4. This, when compared with the record of the 24th inst., which gave a minimum of —41°.8, shows a change of 36°.4. This effect is due to the S. E. wind, and is sometimes much more excessive."

‡ "The wind is from the S'd, and the temperature continues rising; by 9 A. M. of to-day it attained its maximum of +1°.0. At this temperature, the deck house snow thawed and became very wet; snow fell freely. This S. wind is very slight, and apparently cannot satisfactorily account for this deviation of temperature, as we have had it constantly from this quarter without such effect. We all suffer much from heat.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In December, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	2 N. E.	2 S. W.	0	2 N. W.	3 S. E.	0	0	0	0	2 S. E.	2 S. E.*	2 S. E.	2 S. E.	0	0
2	1 N. E.	"	1 S.	1 N. W.	4 S. E.	"	"	"	"	"	1 S. E.*	3 S. E.	"	"	"
3	0	1 S. W.	"	"	2 S. E.	1 W.	"	"	"	"	"	0	3 S. E.	"	"
4	"	3 W.	"	"	1 W.	1 S.	"	"	"	1 S. E.	2 S.	"	"	"	"
5	"	1 W.	"	"*	2 W.	0	"	"	"	0	0	"	1 S. E.	"	"
6	"	0	0	2 N. W.*	1 W.	"	"	"	"	"	"	3 N. E.	"	"	"
7	"	"	"	5 N. W.*	3 S. W.	"	"	1 N.	"	1 S. E.	"	"	"	"	"
8	"	"	"	4 N. W.*	3 S.	1 N. W.	"	0	"	"	"	2 N. E.	"	1 S. E.	"
9	"	2 S. E.	2 N. W.	1 N.	1 S.	"	"	"	"	2 S. E.	"	0	0	"	"
10	1 S. E.	1 S. E.	1 N. W.	"	"	0	1 S.	"	"	1 S. E.	1 S.	2 S.	"	"	"
11	0	"	"	0	"	"	"	1 S. E.	"	2 S. E.	2 S. E.	2 S. E.	"	"	"
Noon	"	3 S. E.	"	"	0	"	"	"	"	10 S.†	"	5 E.	"	"	"
13	"	3 S.	0	2 S.	"	"	0	1 S.	2 S. E.	9 S. E.	1 S. E.	7 S. E.	"	"	"
14	"	1 S.	"	4 S. E.	"	"	1 S. E.	0	"	6 S. E.	2 S. E.	4 S. E.	"	"	"
15	"	0	"	3 S. W.	"	"	0	"	"	2 S. E.	3 N. E.	3 S. E.	"	"	"
16	"	"	"	2 S. W.	1 N.	2 S. E.	"	1 S.	1 S. E.	1 S. E.	1 N. E.	6 S. E.	"	"	"
17	1 S.	1 S. E.	"	2 S. E.	0	1 S.	"	0	"	2 S. E.	"	2 S. E.	"	"	"
18	3 S.	1 S.	2 S.	1 S. E.	"	"	"	"	"	4 N. E.	0	3 S. E.	"	"	"
19	6 S.	"	2 S. W.	"	"	0	"	1 S. W.	"	2 E.	"	2 S. E.	"	"	"
20	1 S.	0	3 S. W.	"	"	"	"	"	"	2 S. W.	2 N. E.	1 S. E.	"	"	"
21	"	"	0	"	"	"	"	0	2 S. E.	2 W.	1 N. E.	0	"	"	"
22	0	"	"	2 S. E.	"	"	"	"	1 S. E.	0	0	"	"	"	"
23	1 S. E.	"	"	2 E.	"	"	"	"	3 S. E.	"	"	1 S. E.	"	"	"
Midn't	1 S.	"	"	0	"	"	"	"	1 S. E.	4 N. E.	1 S. E.	3 S. E.	"	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	1 S. E.	0	2 N. E.	1 S.	0	1 S. E.	1 S. W.	1 S. W.	2 S. E.	0	0	0*	8 S. E.	2 S. E.	0	1 S. E.*
2	"	"	2 S. E.	"	"	"	"	1 S.	"	"	"	"*	"	5 S. E.	"	"*
3	"	"	1 N.	2 S.	1 S. E.	"	"	2 S.	6 S. E.	3 S. E.	"	1 W.*	10 S. E.	2 S. E.	"	2 S. E.*
4	"	"	0	1 S.	2 S. E.	0	"	1 S.	7 S.	5 S. E.	"	"*	8 S. E.	2 S.	"	1 S.*
5	0	"	"	0*	1 E.	"	"	2 S. E.	4 S. W.	4 S. E.	2 W.	"*	4 W.*	3 W.*	"	2 W.
6	"	"	"	"*	2 E.	1 N. E.	"	3 S. E.	6 S. W.	2 S.	"	"*	9 S. W.*	4 W.	2 S.	2 N. W.*
7	"	"	"	1 N. W.*	2 S.	1 N. W.	"	"	6 W.	1 S.	"*	"*	8 W.*	3 S.	1 S.	1 N. W.*
8	"	"	"	2 N. W.*	1 S.	"	2 S. E.	1 S. E.	"	"	1 W.*	2 S.*	7 W.	2 W.*	1 S. W.	"*
9	"	"	"	1 N. W.*	1 S. E.	0	1 S. E.	2 S. E.	6 S. E.	0	0*	0*	7 S. W.	1 S.	1 S.	"
10	"	"	"*	2 N. W.*	"	"	"	1 S. E.	6 E.	"	2 E.*	"*	5 S. W.	"	0	"
11	"	"	"*	1 N. W.*	"	"	0	"	"	"	1 S. E.*	"	2 S. W.	"	"	"
Noon	"	"	"*	"*	"	"	"	4 S. E.	5 E.	"	0*	"	3 S.*	"	1 S.	"
13	"	"	"*	"*	"	"	"	3 S. E.	6 E.	"	1 S.*	"	5 S.*	1 S. W.	0	2 W.
14	"	"	"*	0*	"	"	"	2 S. E.	6 S.	"	"*	"	7 S. W.*	"	"	3 N. W.
15	"	"	"	"	0	1 S. E.	"	1 S. E.	"	1 S. W.	0*	"	8 S.*	0	"	2 N. W.
16	"	"	"	1 N. W.	2 S. E.	"	"	0	"	"	"*	"	5 S. E.*	"	"*	1 N. W.
17	2 S. E.	"	1 N. W.	0	0	0	"	"	5 E.	0	"	"	8 S. E.	"	"	0
18	1 S. E.	"	2 N. W.	1 S. E.	"	"	"	"	5 S. E.	"	"	"	"	"	"	1 N. W.
19	"	"	1 N. W.	0	"	"	"	"	4 S. E.	"	"	"	"	"	"	0
20	"	"	"	"	"	"	"	1 S. E.	"	"	"	"	"	"	"	"
21	0	"	0	"	"	1 S. E.	"	0	2 S. W.	"	"*	1 W.	10 S. E.	"	"*	"*
22	"	"	"	"	"	"	"	1 W.	2 S. E.	"	"*	"	9 S. E.	1 S. E.	"*	"*
23	"	"	"	"	"	"	"	"	2 N. W.	"	"*	"	6 S. E.	0	"*	"*
Midn't	"	1 N. E.	"	"	3 S. E.	0	"	0	0	"	"*	"	5 S. E.	"	"*	"*

* Snowing.

† "Temperature rising, and wind blowing heavily; very dark and cloudy."

"Temperature at noon Dec. 8th, —13°.5; wind S. E. and generally calm. Temperature at noon Dec. 9th, —31°.5; wind S. E. or calm. Temperature at noon Dec. 10th, —10°.5; wind S. E. and heavy blow. The connection of the rise of temperature with the wind is embarrassing."

Dec. 12th. Calm, with squalls at intervals.

Dec. 24. "4 to 8 A. M., overcast, and blowing heavy from S. W. and W. 12 to 4 P. M., thickly overcast, and strong breeze from the S."

Dec. 28. The twenty-four hours have been characterized by the only heavy gale of wind experienced in Smith's Strait since the closure of our winter harbor. The wind rose to No. 8, blowing in squalls from the S. E., and, after 2 A. M., blew a regular gale (No. 10). Temperature rose from —6°.4 at midnight, to +16°.5 at 5 A. M.; difference nearly 23°.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In January, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0*	0	0*	2 N.*	0	0	0	4 S.	1 S. E.	0	0	0	1 S.	0	0
2	"*	1 S.	"*	"*	"	"	3 S. E.	2 S.	"	1 S. E.	"	"	"	"	"
3	1 S. E.*	"	"*	"*	1 S. E.	"	2 S. E.	1 S.	"	"	"	1 S. E.	"	1 S. E.	"
4	"*	"	"*	"*	"	"	"	"	1 S.	"	"	3 S. E.	"	0	"
5	"*	0	"*	2 W.*	"	2 S. W.	1 S. E.*	"	0	"	"	"	2 S.	"	"
6	"*	"	"*	1 W.	"	1 S. W.	3 W.	"	"	"	"	"	1 S.	"	"
7	"*	"	"*	"	"	2 S. E.	2 W.*	"	"	"	"	"	2 N. E.	"	"
8	2 S. E.*	"	"*	2 S. E.	1 N.	1 S.	3 S.*	"	"	"	"	"	1 N. E.	"	"
9	1 S. E.	"	1 S. E.*	1 S. E.	"	1 N. E.	2 S.	0	"	0	"	"	"	"	"
10	0	"*	2 S. E.*	"	"	"	"	"	"	"	"	"	"	"	"
11	1 S. W.	4 W.	1 S. E.*	"	"	"	1 S.	"	"	"	1 S.	1 S.	2 N. W.	"	"
Noon	2 S. W.	2 W.	2 S. E.*	"	"	"	3 S.	"	"	"	"	1 S. W.	1 N. W.	"	"
13	0	4 S. W.	1 S. E.*	"	"	0	3 S. W.	"	"	"	"	"	0	"	"
14	"	"	4 S. E.	"	"	"	2 S.	"	"	"	"	"	"	"	"
15	"	2 S. W.	1 S.*	1 S.	"	"	"	"	"	"	"	"	"	"	"
16	"	3 S. W.	2 S.*	"	0	"	"	"	"	"	"	"	"	"	"
17	"	0	1 S. E.	0	"	"	0	"	"	"	"	0	"	"	"
18	"	1 S. E.	"	"	"	"	"	"	"	"	"	"	"	"	"
19	"	"	"	"	1 S. E.	"	"	"	"	"	"	"	"	"	"
20	"	0	0	"	0	"	"	"	"	"	"	"	"	"	"
21	"	1 N.	2 S.*	"	"	3 W.	1 S. E.	"	1 S.	"	"	2 S.	"	"	"
22	"	1 N. W.	0*	"	"	"	2 S. E.*	1 W.	"	"	"	"	"	"	"
23	"	1 W.	"*	"	"	2 W.	1 S. E.*	2 W.	0	"	"	2 S. E.	"	"	"
Midn't	"	0	"*	"	"	3 S. W.	4 S. E.*	0	"	"	"	1 S.	"	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	0	1 S.	0	0	2 S. E.	0	1 N. W.	1 E.	0	1 S.	2 N. W.	0	0	0	2 N. W.	1 S.
2	"	"	"	"	1 S. E.	"	1 S. E.	"	"	"	0	"	"	"	"	"
3	"	"	"	"	"	"	2 N. W.	2 S. E.	"	1 S. E.	"	"	1 S. E.	2 S.	1 N. W.	2 S.
4	"	"	"	"	"	"	1 E.	"	"	"	"	"	1 S. W.	"	1 S. W.	1 S.
5	"	1 N. W.	"	"	0	"	2 N. E.	0	1 S.	2 S. E.	"	3 S. W.	0	0	1 S. E.	0
6	"	"	"	"	"	"	1 E.	"	1 W.	"	"	2 S. W.	3 S. E.	"	1 N.	"
7	"	"	"	"	"	"	1 N.	"	"	1 S. W.	"	1 S. W.	1 S. W.	"	"	"
8	"	"	"	"	"	"	"	"	"	"	"	"	0	"	1 N. W.	"
9	"	0	"	"	"	2 S. E.	2 N.	1 S. W.	"	0	"	"	1 W.	"	0	1 S. E.
10	"	"	"	"	"	1 S. E.	"	"	0	"	"	"	0	1 S.	"	1 S.
11	"	"	"	"	"	0	"	1 S.	1 N.	"	"*	0	"	"	"	"
Noon	"	1 S. E.	1 S. E.	"	"	2 S. E.	1 N.	"	1 N. W.	"	2 S. W.	"	"	"	"	"
13	"	0	0	"	"	1 N. W.	"	0	1 S. E.	"	"	1 S. E.	"	"	"	0
14	"	"	"	1 N. W.	"	2 W.	"	1 S. E.	"	"	1 S.	2 S. E.	"	"	"	"
15	"	"	"	"	"	1 W.	0	"	1 N.	"	"	1 S. E.	"	"	0	"
16	"	"	"	1 S. E.	"	1 W.	1 N. E.	"	2 N. W.	"	0	"	"	"	"	"
17	"	"	"	0	1 S. E.	2 S. E.	0	"	0	"	"	0	1 E.	1 S.	"	"
18	"	"	1 S. E.	"	2 S. W.	1 S.	1 S. W.	0	"	"	"	"	0	"	"	"
19	"	"	"	"	1 S. W.	2 S.	1 S.	"	"	"	2 S. E.	"	"	0	2 S. W.	"
20	"	"	"	"	0	- - -	1 S. W.	"	"	"	1 S. E.	"	"	"	1 S.	"
21	"	"	0	2 N.	2 S. E.	1 S. E.	0	"	"	1 S. W.	0	"	"	"	0	"
22	1 S.	1 S. E.	"	1 N.	1 S. E.	- - -	"	"	1 N. W.	"	"	1 W.	2 S. W.	"	2 S. E.	"
23	1 S.W.	"	"	"	"	"	"	"	0	0	"	"	0	"	0	1 E.
Midn't	1 S.	"	"	1 N. E.	"	2 S. E.	"	"	"	"	"	"	"	"	"	0

* Snowing.

January 2d. From 8 to 12 P. M., slight snow and light variable winds.

January 7th. From 4 to 8 A. M., heavy bank of clouds to S. E.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In February, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.
1h.	1 S.	0	0	1 S. E.	1 W.	2 S. E.	0	1 S. E.	1 S. E.	0	2 E.	3 S. E.	2 S. E.	1 S. W.
2	"	"	"	0	"	"	"*	"	"	"	3 S.	3 S.	"	2 E.
3	0	"	"	"	0	3 S. E.	"	"	2 E.	"	3 S. E.	4 S.	1 S. E.	2 S. E.
4	"	"	"	"	"	1 S. E.	"	"	1 E.	"	2 S. E.	5 S.	2 S. E.	1 S.
5	"	"	"	1 S. W.	1 N. W.	1 N. W.	2 E.	0	0	1 S. E.	0	6 S.	0	0†
6	"	"	"	0	0	"	"	"	"	2 S. E.	"	3 S.	1 S.	1 E.
7	"	"	"	1 N. W.	"	2 N.	7 S.	1 E.	"	1 S.	"	2 S. E.	2 S.	"
8	"	"	1 N.	"	"	1 N.	8 S.	"	1 S.	2 S. W.	"	"	3 S.	"
9	"	"	0	0	"	2 S. W.	5 S.	3 S. E.	3 S. E.	3 S. W.	2 S. E.	3 S. E.	0	0
10	2 N. W.	"	"	"	"	1 S. W.	6 S.	"	1 S. E.	5 S. W.	1 S. E.	"	"	1 E.
11	"	"	"	"	"	"	8 S. E.	2 S. E.	"	"	0	1 S. E.	"	0
Noon	1 N. W.	"	"	"	1 S.	"	10 S.	3 S. E.	"	6 S. W.	2 S. E.	"	"	"
13	0	"	"	"	0	1 S.	7 S. E.	"	0	"	1 S. E.	2 S.	"	1 E.
14	"	"	"	"	"	0	5 S. E.	2 S. E.	"	"	0	4 S. W.	"	0
15	1 S.	"	"	"	"	"	5 S.	"	"	5 S. W.	"	2 S. W.	"	"
16	"	"	"	"	"	1 S.	4 S.	1 S. E.	"	3 S. W.	"	4 S. W.	"	"
17	0	"	"	"	1 S.	1 S. E.	2 S.	1 E.	1 S. E.	4 E.	2 S. E.	"	1 S. E.	1 S. W.
18	"	"	"	"	"	"	2 S. W.	"	2 S.	"	5 S. E.	5 S. W.	2 S. E.	2 S. W.
19	"	"	"	"	2 S.	"	3 S. W.	1 S. E.	1 S. W.	5 E.	6 S. E.	4 S. W.	1 S. E.	1 S. W.
20	"	"	"	1 S.	1 S.	"	3 S.	1 N.	"	1 S. E.	8 S. E.	"	2 S.	"
21	"	"	"	0	"	0	2 S. E.	0	0	"	2 S. E.	2 S. W.	"	0
22	"	"	"	"	2 S.	"	1 S. E.	"	"	"	3 S. E.	1 S. W.	3 S.	"
23	1 E.	"	"	"	1 S.	"	2 S. E.	3 S. E.	"	2 N.	1 S. E.	2 S. W.†	"	"
Midn't	0	"	"	"	1 E.	"	1 S. E.	"	"	"	"	"	1 S.	"

Hour.	15th.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.
1h.	0	10 S.W.†	1 S. E.†	0	1 S.	0	1 W.	0	0	0	3 S. E.	3 S. E.	0	0
2	"	7 S.	"†	"	2 S.	"	0	1 S. E.	"	"	4 S. E.	1 S. E.	"	"
3	1 S. W.†	5 S.	0	1 S.	0	1 N. E.	"	"	"	"	3 S. E.	0	"	"
4	0	4 S.	"	0	"	1 S. E.	"	0	2 S.	"	"	"	"	"
5	"	2 S. W.	"	"	1 E.	"	2 E.	"	"	"	"	1 S. E.	"	2 S. W.†
6	"	1 S. W.	"	2 S. E.	0	"	2 S. E.	"	1 S.	"	"	"	1 S. W.	1 S. W.
7	"	2 S. W.	2 S.	0	1 S.	2 W.	1 S. E.	"	1 W.	"	2 S. E.	0	2 S. W.	"
8	"	"	1 S.	"	0	1 W.	4 S. E.	"	0	"	1 S. E.	1 S. E.	1 S. W.	"
9	1 E.	1 S. W.	0	"	"	2 W.	1 N. W.	"	"	1 S.	0	0	1 N. W.	0
10	2 E.	"	1 S.	"	"	"†	"	"	"	"	"	"	0	1 E.
11	1 S.	"	"	"	"	1 S.	"	"	"	"	"	"	"	1 S. E.
Noon	2 S. W.	1 S. E.	0	"	"	2 S. E.	"	"	"	0	"	"	2 S. E.	"
13	4 S. W.	0	"	"	"	1 S. E.	"	"	"	2 S.	"	"	0	0
14	3 S. W.	"	"	"	"	0	"	"	"	1 S.	"	"	"	"
15	5 S. W.	"	"	1 E.	"	1 S. E.	0	2 S.	"	2 S.	1 S. E.	"	"	"
16	"	2 S. W.	1 W.	0	"	0	"	1 S.	"	1 S.	2 W.	"	"	"
17	3 S. W.	1 S.	0	"	"	"	1 S. E.	0	2 S.	0	0	"	1 S. E.	"
18	5 S. W.	0	"	"	"	"	0	"	1 S.	"	"	1 E.	"	"
19	3 S. W.†	"	1 S. W.	"	"	"	"	"	3 S.	1 S. E.	1 S. E.	0	"	"
20	2 S. W.†	"	2 S. W.	"	"	"	"	"	2 S.	"	"	"	"	"
21	6 S. E.†	"	2 N. W.	1 W.	"	"	2 S. E.	"	0	2 S.	"	"	"	"
22	"†	1 S. E.†	1 S. W.	0	"	"	1 E.	"	1 S.	0	2 S. E.	"	0	"
23	8 E.†	3 S. E.†	0	"	"	"	0	"	2 S.	1 S.	1 S. E.	"	"	"
Midn't	9 E.†	2 S. E.†	"	"	"	"	1 N.	"	1 S. W.	1 S. W.	"	"	"	1 S.

* Between the hours of 2 and 4 A. M., the temperature was elevated 22°.5. The wind then set in from the E'd, hauled to S'd, and blew a gale (No. 10). Temperature rose as high as —20°.5 at noon. These warm changes are very trying to the health, and curious in their relation to the winds.

† Snowing.

February 15th and 16th. Strong wind between 24h. and 1h., blowing a heavy gale (No. 10).

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In March, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	1 N. E.	1 S.	0	0	2 S.	2 S. W.	0	1 W.	2 S. W.	0	0	0	0	0	0
2	"	"	"	"	"	0	"	"	3 E.	1 W.	"	"	"	"	"
3	0	"	"	"	"	"	"	0	3 S.	0	"	"	"	"	"
4	"	2 S.	"	"	"	"	1 W.	"	5 E.	"	1 W.	"	"	"	"
5	"	0	"	"	"	"	0	"	2 S. E.	"	0	"	"	"	1 S. E.
6	"	"	"	"	"	"	"	"	"	1 S. E.	"	"	"	"	"
7	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
8	"	"	"	"	0	"	"	"	1 S. E.	0	"	"	"	"	"
9	"	"	1 S.	"	1 S. E.	"	"	"	2 S. E.	"	"	"	"	"	3 S.
10	"	"	"	"	1 S.	"	"	"	"	"	"	"	"	"	"
11	"	"	"	"	2 S. W.	1 W.	"	"	"	"	"	"	"	"	2 S.
Noon	1 S.	1 S.	0	"	1 S. W.	"	"	"	"	"	"	"	"	"	3 S.
13	0	"	1 S.	1 S.	"	"	"	1 W.	"	"	"	"	1 S.	"	"
14	"	2 S.	0	"	0	"	"	"	1 N. W.	"	"	"	0	"	2 S.
15	"	1 S.	"	0	"	1 E.	"	0	"	"	"	"	"	"	0
16	"	"	1 W.	"	"	0	1 S. E.	"	"	"	"	"	"	"	1 W.
17	"	"	0	"	"	"	0	"	0	"	"	"	"	"	2 S. E.
18	"	2 S.	"	"	"	"	"	"	"	"	"	"	"	"	"
19	"	1 S.	"	"	"	"	"	"	"	"	"	"	"	1 S. W.	"
20	"	"	"	"	"	"	"	"	"	"	"	"	"	0	3 S. E.
21	"	"	"	"	"	"	"	"	"	"	"	"	"	"	4 S.
22	"	"	"	"	"	"	"	1 S. E.	"	"	"	"	"	"	"
23	"	"	"	1 S.	"	"	"	0	"	"	"	"	"	"	"
Midn't	"	0	"	2 S.	"	"	"	"	"	"	"	"	"	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	3 S.	0	0	1 N. W.	0	1 S.	1 S. E.	2 S. E.	1 W.*	0	0	1 S.	0	3 S. E.	0	0
2	2 S.	"	"	0	"	"	"	4 S. E.	1 N. W.*	2 S.	"	4 S.	"	"	"	"
3	3 S.	"	"	"	"	"	"	1 S. E.	2 N. W.*	1 S.	"	2 S. E.	"	2 S. E.	"	"
4	1 S.	"	"	"	"	"*	"	"	"*	0	"	1 S. E.	"	"	"	"
5	"	"	"	"	"	0*	0	"	0*	1 S.	"	1 S.	"	1 S. E.	"	"
6	"	"	"	"	"	"*	1 S. E.	1 S.	"*	2 S.	"	2 S. E.	"	2 S. E.	"	1 N.
7	"	"	"	"	"	"*	2 S. E.	"*	1 W.*	1 S.	"	3 S. E.	"	1 S. W.	"	"
8	"	"	"	"	1 S.	"*	3 S. E.	"*	"*	"	"	"	"	0	"	0
9	2 S.	"	"	"	1 S. E.	"	0	0	"*	"	"	1 S. E.	"	"	"	"
10	1 S.	"	"	"	0	"	1 S.*	1 N. W.	"*	"	1 N. W.	"	"	"	"	"
11	"	1 S.	"	"	1 S. E.	1 S. W.*	"*	0	"*	0	"	"	1 S.	"	"	"
Noon	"	1 S. W.	"	2 N. W.	0	"*	"	"	2 W.*	"	"	"	"	"	"	"
13	"	0	"	0	1 S. E.	0	0	1 W.*	"*	"	0	"	0	"	"	"
14	"	"	"	"	2 S. E.	"	1 S.	"*	3 W.*	"	"	"	"	"	"	"
15	"	"	"	"	1 S. E.	"	"	0*	3 N. W.*	"	"	"	1 S. E.	1 S. W.	"	"
16	0	"	"	1 S. E.	1 S. E.	"	"	"*	4 N. W.*	"	"	"	"	"	"	"
17	1 S. W.	"	"	0	0	"	0	"*	"*	"	"	2 S. E.	"	"	"	"
18	"	"	"	"	"	"	"	"*	"*	"	"	"	"	0	"	"
19	"	"	"	"	"	"	"	"*	2 N. W.	"	"	1 S. E.	1 S.	1 S.	"	"
20	"	"	"	"	"	"	2 S.	"*	4 N. W.	"	"	"	2 S.	0	"	"
21	1 N. W.	"	"	1 S.	"	"	2 S. E.	2 W.*	3 N. W.*	"	"	"	0	1 S.	"	2 S.
22	"	"	"	0	"	1 S.	2 S.	"*	2 N. W.*	"	1 S.	"	4 S.	"	1 W.	"
23	0	"	"	"	1 S.	0	0	"*	1 N. W.	"	"	0	"	"	"	3 S.
Midn't	"	"	"	"	"*	"	2 S. E.	"*	0	"	"	1 S. E.	2 S. E.	2 N. W.	"	6 S.

* Snow.

March 9th. Between the hours 1 and 2 A. M., the temperature rose 13°.5.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In April, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	6 S. W.	2 S. E.	- - -	2 N.	1 S.*	1 S. W.	1 S.	1 S.	0	1 S.	3 S.	1 S.	3 S.	6 S. W.	3 S. W.
2	4 S. W.	3 S. E.	"	"	"*	3 S. W.	2 S.	"	"	"	1 S.	"	2 S.	7 S. W.	4 S. W.
3	5 S. W.	"	"	"	0*	4 S. W.	3 S.	- - -	1 S. E.	0	"	"	1 S.	6 S. W.	3 S. W.
4	3 S. E.	2 S. E.	"	"	"*	3 S.	"	"	2 S.	"	"	"	3 S.	4 S. W.	1 S. W.
5	3 S.	"	"	2 S. E.	"*	2 S. W.	2 S.	0	0	2 S. W.	0	"	0	5 S. W.	4 S. E.
6	2 S.	3 S. E.	"	1 S. E.	"	1 S. W.	1 S.	"	1 S.	1 S. W.	"	0	"	4 S. W.	2 S. E.
7	3 S.	"	"	"	"	3 S. W.	"	1 S.	0	0	"	"	"	"	3 S. E.
8	2 S.	1 S. E.	"	4 S. E.	"	"	"	1 S. E.	"	"	"	"	"	3 S. W.	4 S. E.
9	3 S.	"	"	1 S. E.	1 S.*	"	0	2 S.	"	2 S.	1 S.	1 S.	"	"	3 S. E.
10	2 S.	"	"	2 S.	"*	2 S. W.	"	1 S.	"	1 S.	"	"	1 S.	"	2 S. E.
11	"	"	"	1 S.	"	"	"	"	"	"	2 N.	1 S. W.	"	4 S. W.	1 S.
Noon	"	"	"	"	"	1 S. W.	"	0	"	1 S. E.	1 N. W.	0	0	3 S. W.	"
13	1 S.	- - -†	0	- - -	2 S. W.	1 S.	1 S.	"	1 S. E.	1 S.	1 N.	"	"	4 S. W.	2 S. E.
14	"	"	"	"	"	"	2 S.	1 S. W.	"	0	0	1 N. W.	"	"	"
15	"	"	"	"	1 S.	"	1 S.	"	"	"	"	"	"	"	1 E.
16	"	"	"	"	"	"	0	1 S.	0	"	"	"	"	"	"
17	0	"	"	2 S. W.	0	"	"	2 S. E.	"	"	1 S.	1 S.	"	3 S. W.	1 S. E.
18	"	"	"	1 S. W.	1 S. W.	0	"	1 S. W.	"	"	"	"	"	2 S. W.	0
19	"	"	"	1 S. E.*	- - -	"	"	0	"	3 S.	"	2 S.	"	1 S. W.	2 S. E.
20	"	"	"	"*	"	"	"	"	"	2 S.	"	"	"	2 S. W.	"
21	"	"	"	"*	1 W.*	"	1 S.	1 S.	1 S.	"	"	1 S. W.	"	4 S. W.	3 S.
22	"	"	"	2 S. E.*	"	"	"	"	"	"	"	1 S.	2 S.	3 S. W.	6 S. W.
23	2 S. E.	"	"	"*	"	1 S. W.	0	2 S. E.	"	3 S.	2 S.	"	"	2 S. W.	10 S. W.
Midn't	"	"	"	"*	"	"	1 S.	1 S. E.	"	"	3 S.	"	"	1 S. W.	10 S.

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.
1h.	8 S. W.	0	1 N.	1 N.	1 S. W.	0	3 S. W.	1 N. W.	1 S. E.	2 N. W.	0	1 S.	1 S. W.	1 S. E.	3 S. E.
2	"	"	"	"	"	"	1 S. W.	0	"	1 N. W.	"	"	"	"	1 E.
3	"	"	0	"	0	"	"	1 N. W.	0	0	1 S. E.	"	"	"	0
4	"	"	1 S.	"	"	2 N. W.	0	"*	"	"	"	"	"	"	"
5	7 S. W.	"	"	0	"	1 N. W.	"	1 W.	"	"	"	"	0	0	1 S.
6	4 S. W.	1 S.	"	"	"	0	"	0	"	1 N. W.	"	"	"	"	"
7	2 S. W.	0	0	"	"	"	"	"	"	"	"	0	"	"	"
8	1 S. W.	"	"	"	(8 N. W.‡)	"	"	"	"	"	0	"	"	"	"
9	"	"	1 N.	"	0	"	"	"	"	2 N. W.	"	"	"	"	0
10	"	"	"	"	"	1 N.	"	"	"	"	"	"	"	"	"
11	0	"	"	1 N.	"	1 N. W.	"	"	"	"	"	"	"	"	"
Noon	1 S.	"	"	"	"	"	"	"	"	"	"	"	"	"	1 N. W.
13	1 S. W.	1 N. W.	"	"	"	"	1 S.	1 N. W.	"	"	"	"	"	"	0
14	"	"	"	"	1 N. W.	"	"	"	"	1 N. W.	"	"	"	"	"
15	0	"	"	"	0	"	"	"	"	"	1 S.	"	"	"	"
16	1 S. W.	"	1 N. W.	"	"	"	"	"	"	"	"	"	"	"	"
17	0	"	0	"	"	0	"	0	"	2 S. E.	"	"	"	"	"
18	"	"	"	"	"	"	0	"	"	"	"	"	"	"	"
19	1 S. E.	"	"	"	"	"	"	"	"	0	2 S.	"	"	"	"
20	"	"	"	"*	"	"	"	"	"	"	"	"	"	"	"
21	"	"	"	"*	"	"	"	"	"	- - -	1 S.	"	1 S. E.	1 S. E.	"
22	"	"	1 S.	"*	"	"	"	"	"	"	"	"	2 S. E.	"	"
23	0	"	"	"*	"	"	"	"	"	"	"	"	"	"	"
Midn't	"	"	"	1 S. W.*	"	"	"	"	"	"	"*	"	"	"	"

* Snow.

† No observations, on account of the confusion attendant upon the returning party.

‡ This entry seems to be doubtful. The temperature, beyond a great diurnal variation, is but slightly affected, and the barometer not at all. Since there is no mention made in the notes of any sudden squall, I prefer to omit the entry altogether.

April 1st. Wind contiuues blowing from the S'd and S. W'd, increasing to a gale.

April 15th. About 9 P. M., the wind shifted to S. W., blowing a gale, with heavy snow drift.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In May, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	2 N. W.	1 N. W.*	0	4 S. E.	1 N. W.*	0	1 S. E.	1 S. W.	1 S.	2 S. W.	1 N.	1 N. W.*	1 N. W.	0	1 S. W.
2	"	"*	"	"	"*	"	"	"	2 S.	4 S. W.	"	"	"	"	"
3	"	"*	"	3 S. E.	"*	"	"	2 S. W.	"	3 S. W.	"	"	"	"	"
4	3 S. W.	"*	"	0	"*	"	3 S. E.	3 S.	1 S.	2 S. W.	"	"	"	"	"
5	1 S. E.	"*	1 N. W.*	"	"*	"	5 S. E.	5 S.	0	1 S. W.	1 W.	"	"	"	1 S.
6	0	"*	"*	1 S. E.	"*	"	"	6 S.	"	"	"	"	"	"	1 S. E.
7	1 S. E.	"*	"	"	"*	"	"	4 S.	1 S.	"	1 S. W.	"	"	"	"
8	"	"*	"	"	0*	"	1 S. E.	3 S.	3 S.	"	"*	"	"	"	0
9	2 S.	"*	"	3 S. E.	"*	"	1 S.	"	1 S.	1 S. W.	"*	2 S.	"	"	1 N. W.
10	"	2 N. W.*	"	1 S. E.	"*	"	2 S.	4 S.	1 N. W.	2 N.	"*	1 S.	"	"	"
11	1 N. W.	1 N. W.*	"	1 N. W.	"*	"	4 S.	"	"	3 N.*	1 N.*	1 N. W.	"	"	"
Noon	"	"*	"	"	"*	"	3 S.	3 S.	"	"*	"	"	"	"	"
13	"	2 N. W.*	"	2 N. W.	"*	"	6 S.	"	"	2 N.*	1 S. W.	0	"	"	"
14	"	"*	"	"	"*	"	"	2 S.	"	"*	"	"	"	"	"
15	0	3 N. W.*	"	"	"	"	"	1 S.	"	"*	2 S. W.	"	"	"	"
16	1 N. W.	"*	"	3 N. W.	"	"	7 S.	"	0	1 N.*	"	"	"	"	"
17	"	1 N. W.	"	1 N. W.	"	"	"	"	"	"*	"	"	"	"	"
18	"	"	0	1 S. E.	"	"	4 S.	"	1 N. W.	"*	1 S. W.	"	"	"	"
19	0	"	"	"	"	2 S. E.	2 S.	"	"	"*	"	"	"	"	"
20	"*	"	"	0	"	1 S. E.	4 S.	"	"	"*	2 S. W.	"	"	"	"
21	"*	"	"	"	"	0	3 S.	2 S.	2 S. W.	0*	"	"	"	1 S. W.	"
22	"*	0	"	"	"	2 S. E.*	2 S.	3 S.	4 S. W.	1 N.*	1 S. W.	"	1 W.	"	2 S.
23	"*	"	"	"	"	0	3 S.	1 S.	"	"*	"	"	"	0	1 S.
Midn't	"*	"	"	1 N. W.	"	"	5 S.	2 S.	3 S. W.	"*	"	"	"	1 S. W.	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	1 S. E.	1 S.	0*	2 S. E.	3 S. W.	1 S. W.	5 S. W.	0	0	0	1 W.*	0*	0*	0	0	0
2	2 S. E.	"	"*	4 S. E.	1 S. W.	"	4 S. W.	"	"	"*	0*	"*	"*	"	"	"
3	1 S. E.	"	"*	1 S. E.	"	"	3 S. W.	"	"	"*	"*	"*	"*	"	"	"
4	1 E.	"	"*	2 S. E.	"	2 S. W.	0	"	"	"*	"*	"*	"*	"	"	"
5	"	"	"*	"	"	3 S. W.	1 S. W.	"	"	1 N.*	1 W.*	"*	"*	1 N.W.*	"	"
6	2 E.	"	"*	1 S. E.	"	2 S. W.	2 S. W.	"	"	"*	"*	"*	"*	"*	"	"
7	1 E.	0	1 N. W.*	0	"	3 S. W.	2 S.	"	"	0*	"	"*	"*	"*	"	"
8	"	"	"*	"	"	2 S. W.	1 S. E.	"	"	"	0	"*	"*	0*	"	"
9	"	1 N. W.	0*	1 S. W.	"	3 S. W.	1 S.	1 N.	"	"	1 N.	"*	"	"	"	"
10	0	"	1 N.*	0	1 N. W.	4 S. W.	"	"	1 N.	"	"	"*	"	"*	"	"
11	"	2 N. W.	"*	"	"	"	0	"	"	"	"	"*	"	"*	2 N.	"
Noon	"	"	"*	"	"	3 S. W.	1 N.	"	"	"*	2 N.	"*	"	"	1 N.	1 N.
13	"	"	"*	"	0	"	"	"	"	"*	1 N.	"*	"	"	"	"
14	2 N. W.	"	"*	"	"	"	2 N.	"	"	"	1 N. W.	"*	"	"	"	0
15	"	"	"*	1 S. W.	"	4 S. W.	3 N.	"	0	"*	"	"*	"*	"	"	"
16	"	"	"*	"	"	"	"	1 N. W.	"	1 N.	"	"*	"	0	"	
17	1 N. W.	1 N. W.	"*	"	"	"	"	"	1 N.	"	"*	"*	"	"	"	"
18	0	"	"*	3 S. W.	"	"	2 N.	2 N. W.	"	"	"*	"*	"	"	"	"
19	"	"	"*	"	"	"	"	"	"	"	"*	"*	"	"	"	"
20	"	"	"	2 S. W.	1 S. W.	3 S. W.	"	"	0	1 S. W.	"*	"*	"	"	"	"
21	"	0	1 S. W.	"	3 S. W.	4 S. W.	0	0	"	"	"*	"*	"	"	"	"
22	"	"	3 S. W.	"	2 S. W.	"	1 N.	"	"	"	"	"*	"	"	"	"
23	"	"	2 S. W.	3 S. W.	1 S. W.	"	0	"	"	"	"*	"	"	"	"	"
Midn't	"	"	"	"	2 S. W.	3 S. W.	"	"	"	"*	"*	"	"	"	"	"

* Snowing.

May 7th and 8th. Strong breeze and gale from the S'd; ceased at noon of the 8th.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In June, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0	0	1 S. W.	6 N. E.	0	0	4 N. W.	0	0	0	0	0	1 N. W.	2 N. W.	0
2	"	"	"	5 N. E.	"	"	0	"	1 N. W.	"	"	"	"	3 W.	"
3	"	"	"	"	"	"	3 N. W.	"	"	"	3 N. W.	"	0	4 W.	"
4	"	"	0	"	"	"	"	"	0	"	3 N.	"	"	"	"
5	1 W.	1 S. W.	- - -	- - -	"	1 N. W.	"	"	2 N. W.	"	1 N. W.	1 N. W.	1 N. W.	0	"
6	0	2 S. W.	"	"	1 N. W.	"	"	"	"	"	"	"	1 W.	"	"
7	1 W.	1 S. W.	"	"	"	"	"	"	"	"	"	"	1 N. W.	"	"
8	"	2 N. W.	"	"	"	"	"	"	1 N. W.	"	"	"	1 W.	"	"
9	"	"	1 N.	3 N. W.	"	0*	2 N. W.	"	"	"	2 N. W.	2 N. W.	1 N. W.	"	"
10	"	"	"	"	2 N.	"*	0	"	0	"	"	"	2 W.	"	"
11	"	1 N. W.	"	"	2 N. W.	"	"	"	"	"	0	0	2 N. W.	"	"
Noon	0	2 N. W.	"	"	3 N. W.	"	"	"	3 W.	"	"	1 N. W.	0	"	1 N. W.
13	"	1 N. W.	2 N. W.	5 N.	1 N. W.	"	"	"	0	"	"	"	1 N. W.	"	"
14	"	"	3 N. W.	"	0	"	1 N. W.	"	2 N. W.	"	"	"	6 N. W.	"	0
15	"	"	4 N. W.	"	2 N. W.	3 N. W.	"	3 N. W.	0	"	1 N. W.	"	"	1 N. W.	"
16	"	"	"	"	"	2 N.	3 N. W.	"	4 N. W.	"	"	0	"	0	"
17	"	"	"	3 N. W.	3 N.	0	0	"	"	"	"	2 N. W.	"	"	"
18	"	"	"	"	4 N.	1 N. W.*	2 N. W.	"	2 N. W.	"	"	"	5 N. W.	"	"
19	"	"	3 N. W.	"	2 N. W.	2 W.	1 N. W.	2 N. W.	3 N. W.	1 S. W.	2 W.	"	2 N.	"	"
20	"	"	"	2 N. W.	"	2 N. W.	0	"	"	0	1 N. W.	1 N. W.	1 N. W.	"	"
21	"	0	2 N. W.	2 N.	"	"	"	1 N. W.	2 N. W.	1 S. W.	1 W.	2 W.	1 N.	"	"
22	"	"	"	1 W.	"	1 N. W.	"	"	1 N. W.	- - -	0	4 N. W.	1 N. W.	"	"
23	"	"	"	0	1 N. W.	3 N. W.	"	"	0	"	"	3 N. W.	0	"	"
Midn't	"	"	"	"	2 N. W.	2 N. W.	4 S. W.	"	"	"	"	2 N. W.	1 W.	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.
1h.	0	7 S. W.	0	0	0	1 S. W.*	1 S. W.*	4 N. W.*	0	0	0	0	0	- - -	0
2	"	8 S. W.	"	"	"	2 S. W.*	2 S. W.*	1 N. W.	"	"	"	2 N. E.	"	"	"
3	"	7 S. W.	"	"	"	3 S. W.*	1 S. W.*	0	"	"	"	3 N. E.	"	"	"
4	"	5 S. W.	"	"	"	0	"*	2 N. W.	"	"	"	2 N. E.	"	"	1 S. W.
5	"	3 S. W.	"	"	"	"	0*	4 N. W.*	"	"	"	0	"	0	"
6	"	3 S. W.	"	"	"	"	"*	"*	"	"	"	"	"	"	0
7	"	"	"	"	"	"	"*	"*	"	"	"	"	"	"	0
8	"	1 S. W.	"	"	"	"	"*	"*	"	"	"	"	"	"	"
9	"	"	"	"	"	"	"*	1 N. W.	"	"	"	"	"	"	"
10	"	"	"	"	2 N. W.	"	"	"*	"	"	"	"	"	"	"
11	"	2 S. W.	"	"	2 W.	"	"	"*	"	1 N. W.	"	"	"	"	"
Noon	"	"	"	"	0	"	"	"*	"	2 N. W.	"	"	"	"	"
13	"	0	"	"	"	"	"	0*	"	0	"	"	"	"	"
14	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
15	"	"	"	"	"	"	"	"	- - -	"	"	"	"	"	"
16	"	"	"	"	"	"	1 S. W.	"	"	"	"	"	"	"	"
17	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
18	"*	"	"	"	"	"	0	"	"	"	"	"	"	"	"
19	1 S. W.*	1 S. W.	"	"	"	"*	2 N. W.	1 W.	1 N. W.	3 N.	"	"	"	"	"
20	0*	"	"	"	"	"	"*	"	1 W.	"	"	"	"	"	"
21	"	0	"	"	"	"	3 N. W.*	"	0	2 N.	"	"	"	"	1 N.
22	"	1 W.	"	"	"	"	"*	0	"	1 N. W.	1 N. W.	"	"	"	1 N. W.
23	"	0	"	"	"	"*	4 N. W.*	"	"	"	0	"	"	"	0
Midn't	"	"	"	"	"	"*	- - -*	"	1 N. W.	0	"	"	"	"	1 N. W.
															0

* Snow.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In July, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0	- - -	0*	0	0	0	0	0	0	1 N. W.	1 N. W.	0	0	2 S. E.*	0
2	"	"	"*	"	"	"	"	"	"	"	0	1 W.	"	1 S. E.*	"*
3	"	"*	"	"	2 N. W.	1 N. E.	"	"	"	0	"	"	"	0*	"
4	"	"*	"	3 S. W.	0	0	"	"	"	"	"	0	"	"*	"
5	"	S. E.*	"	1 S. W.	"	1 N. W.	"*	"	2 W.	1 N. W.	1 W.	"	"	"*	"
6	"	"*	"	"	"	"	"	"	1 W.	2 N. W.	"	"	"	"	"
7	"	"*	"	1 N.	"	"	"	"	"	1 N. W.	0	"	"	"	"
8	"	S.*	"	0	"	2 N. W.	"	"†	0	"	1 W.	"	"	"	"
9	"	S. E.	1 N.	"	"	"	"	"†	"	0	0	"	"	"	"
10	"	E.	"	"	"	"	"	"†	"	"	"	"	"	"	"
11	"	"	"	"	"	"	"	"*	"†	"	"	"	"	"	"
Noon	"	S. E.	"	"	"	"	"	"*	"†	"	"	1 N.	"	"	"
13	"	S.	0	"	"	"	"	"*	"	"	"	"	"	"	"†
14	"	"	"	"	"	1 N. W.	"	"*	"	"	"	"	"	"	2 N.
15	"	S. W.	"	"	"	2 N. W.	"	"*	"	"	1 S. W.	1 N. E.	"	"	1 N.†
16	"	"	"	"	"	3 N. W.	"	"*	"	"	1 W.	"	"	"	"†
17	"	"	"	"	1 S. W.	2 W.*	"	"*	"	"	"	1 N. W.	"	- - -	0
18	"	"	"	"	"	1 W.*	"	"*	"	"	"	"	"	"	"
19	"	N. W.	"	"	"	"*	"	"*	"	"	"	2 S. E.	"	0	"
20	"	"	"	"	"	1 N. W.	"	"*	"	"	"	1 E.	"	"	"
21	"	- - -	"	"	0	"	"	"	"	1 W.	0	1 N.	"	- - -	"
22	"	"	"	"	"	"	"	"	"	0	"	"	"	"	3 S. W.
23	1 N. W.*	"	"	"	"	"	"	"	"	"	"	0	"	"	"
Midn't	"*	"	"	"	"	"	"	"	"	"	"	"	"	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	- - -	- - -	- - -	- - -	0	0	0	0	0	0	0*	1 N.	0	5 S. W.	0	0
2	"	"	"	"	"	"	"	"	"	"	"*	2 N.†	"	6 S. W.	"	"
3	"	"	"	"	"	"	"	"	"	"	"*	4 N. W.	1 N. W.	4 S. W.	"	"
4	"	"	"	"	"	"	"	"	"	"	"*	3 N. W.	2 S. E.	"	"	"
5	1 N.	0	0	0	1 W.	"*	"	"	"	"	"*	0	2 S. W.	4 W.	1 W.	- - -
6	"	"	"	"	0	"*	"	"	"	"	"	"	3 S.W.*	3 W.	"	"
7	"	1 S.	"	"	"	"*	"	"	"	"	"	"	5 S. W.	0	2 W.	"
8	"	"	"	"	2 N. W.	1 N.*	"	"	"	"	1 S. E.	"	"	"	"	"
9	"	0	"	"	0	"*	"	"	"	"	1 S.	"	"	"	0	0
10	"	"	"	"	"	1 S.*	"	"	"	"*	1 N.	"	"	"	"	"
11	0	"	"	"	"	"*	"	"	"	"*	1 N. E.	"	6 S. W.	"	"	"
Noon	"	"	"	"	"	"*	"	"	"	"*	"	2 N. W.	6 S.	"	2 N. W.	"
13	"	"	1 E.	"	"	0*	"	"	"	"	2 N.	1 N. W.	6 S. W.	3 N.	3 W.	"†
14	1 N.	1 N.	0	"	2 N. W.	"*	"	"	"	"	3 N. E.	1 W.	6 S.	0	3 N. W.	"
15	5 S.	"	"	"	1 N. W.	"*	"	"	"	"	0	0	8 S. W.	"	2 N. W.	"
16	6 S.	0	1 S.	"	"	"*	"	"	"	"	"	"	"	"	"	"
17	"	"	0	"*	"	"	"	1 W.	"	"	"	"	"	3 N. W.	"	"
18	"	"	"	"*	"	"	"	"	"	"	"	"	"	"	3 N. W.	"
19	"	"	"	"*	"	"	"	"	"	"	"	"	7 S. W.	"	4 N. W.	"
20	"	"	"	"*	"	"	"	"	"	"	"	"	"	0	3 N. W.	"
21	4 S.	- - -	"	"	"	"	"	1 N. W.	"	"	"	"	6 S. W.	"	1 N. W.	"
22	3 S.	"	"	"	"	"	"	"	"	"	"	"	2 S. W.	"	"	"
23	2 S.	"	"	"	0	"	"	"	"	"	"	"	"	"	"	"*
Midn't	0	"	"	"	"	"	"	0	"	"	"*	"	2 S. E.	"	0	"*

* Rain. † Snow.

July 2d. The force of the wind was not noted on this day; estimated force 2.

July 28th. The bergs outside are now in motion.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In August, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0	0	0	1 S. E.	0	0	0	1 N.	0	0	0	0	1 S. E.	0	3 N. W.
2	"	"	1 N. W.	0	"	"	"	1 S. E.	"	"	"	"	"	"	3 W.
3	"	"	1 N.	"	"	"	"	3 N. W.	"	"	"	"	"	"	2 N. W.
4	"	"	1 N. W.	"	"	"	"	1 N. W.	"	"	"	1 S. W.	0	"	0
5	1 W.	"	0	"	1 S. E.	"	"	0	"	"	"	"	1 N. E.	"	"*
6	"	"	"	2 N. E.	1 N.	"	"	"	"	"	"	"	0	1 S. E.	"*
7	1 N. W.	"	1 S. E.	1 N.	"	"	"	"	"	"	"	"	2 N.	"	"*
8	"	"	0	1 S.	0	"	"	"	"	"	"	"	3 N.	0	"*
9	0	"	"	0	"	"	"	"	"	"	"	"	2 N.*	"	"*
10	"	"	"	"	"	"	"	"	"	"	"	"	1 N.	1 N.	"*
11	"	"	"	"	"	"	"	"	"	"	"	0	2 N.	2 S. E.	"*
Noon	"	"	"	"	"	"	"	"	"	"	"	"	1 N.	3 N. W.	"*
13	"	"	"	"	"	"	"	"	"	"	"	"	"	4 W.	"*
14	"	"	"	"	"	"	"	2 S.	"	"	1 W.	"	2 N. W.	2 W.	1 N. W.
15	"	"	"	"	"	"	"	1 S.	"	"	"	"	"	3 W.	0
16	"	"	"	"	"	"	"	"	"	1 S.	"	"	1 N. W.	4 W.	"
17	"	"	"	"	"	"	"	0	"	"	0	"	2 N.	3 N. W.	"
18	"	"	"	"	"	"	"	"	"	"	1 S.	"	1 N.	4 N. W.	"
19	"	"	"	"	"	"	"	"	1 S.	"	"	"	0	3 N. W.	"
20	"	"	"	"	"	"	"	"	"	"	"	"	"	2 N. W.	"
21	"	"	"	"	"	"	"	"	"	0	"	"	"	4 N. W.	"
22	"	"	"	"	"	"	"	"	"	"	"	1 S. E.	"	3 N. W.	"
23	"	"	"	"	"	"	"	"	"	"	"	"	"	4 N. W.	"
Midn't	"	"	"	"	"	"	"	"	"	"	"	"	"*	0	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	0	0	0	1 N. W.	0	0	0	2 S. E.	0	0	0*	- - -	- - -	2 S. E.	7 S.	5 S.
2	"	"	2 N.	0	"	"	"	1 S. E.	"	"	"	"	"	3 S. E.	"	"
3	"	"	4 N.	"	"*	"	"	0	"	"	"	"	"	"	"	"
4	"	"	2 N.	"	"*	"	"	"	"	"	"	"	"	"	"	"
5	"	"	2 N. W.	1 N.	"*	"	"	1 S. E.	"	"	"	1 S. E.	"	3 E.	1 S.	4 S.
6	"	"	2 W.	"	1 N. W.*	"	"	0	"	"	"	"	"	5 S. E.	"	3 S.
7	"	"	"	0	"*	"	"	"	1 S.	"	"	"	"	6 S. E.	1 E.	"
8	"	"	"	1 E.	"*	1 W.	"	"	"	"	"	"	"	2 S. E.	"	2 S.
9	- - -	2 N.	1 N. W.	1 S. E.	"*	0	"	"	0	"	"	1 S.	"	4 S. E.	1 S. E.	2 S. E.
10	"	"	"	0	3 N. W.*	"	"	"	"	"	"	"	"	3 S. E.	2 S. E.	"
11	"	"	"	1 E.	1 N. W.	"	"	"	"	"	"	"	"	4 S. E.	5 S. E.	2 S.
Noon	"	"	"	"	2 W.	"	"	"	"	"	"	"	"	"	"	"
13	0	3 N. W.	2 N. W.	1 S. E.	"	"	"	"	"	"	"	"	"	5 S. E.	- - -	"
14	"	2 N. W.	2 N. E.	0	"	"	"	"	"	"	"	"	"	6 S.	"	0
15	"	"	0	"	2 N. W.	"	"	"	1 S.	"	1 S. E.	"	"	"	"	"
16	"	3 N. W.	"	"	3 N. W.	"	"	"	"	"	"	0	"	"	"	"
17	"	1 N. W.	2 N. W.	"	1 N. W.	"	"	"	"	"	"	"	"	"	"	"
18	"	0	3 N. W.	"	"	"	"	"	1 S. E.*	"	"	"	"	"	"	- - -
19	"	1 S. E.	"	1 E.	"	1 S.	"	"	2 S. E.	"	"	"	"	"	"	"
20	"	"	4 N. W.	"	"	"	"	"	"	"	- - -	"	"	"	"	"
21	"	"	3 N. W.	2 E.*	"	"	"	"	1 S. E.	2 S. W.	"	"	"	6 S. E.	3 S. E.	0
22	"	0	"	"*	0	"	"*	"	3 N. W.	1 S. W.	"	"	"	"	"	"
23	"	1 S. E.	4 N. W.	1 N.*	"	0	"	"	1 N. W.	2 S. W.	"	"	"	"	4 S. E.	"
Midn't	"	0	"	0	"	"	"	"	1 S. E.	0	"	"	"	6 S.	4 S.	"

* Snow.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In September, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0	- - -	0*	0	0	0	0	0	0	0	0	0	0	1 S. W.	0*
2	"	"	"*	"	"	"	"	"	"	"	"	"	"	"	"*
3	"	0	"*	"	"	"	"	"	"	"	"	"	"	0	"*
4	"	"*	"*	"	"	"	"	"	"	"	"	"	"	"	"*
5	"	"*	"	"	1 S.	"	"	"	"	"	"	"	1 N. W.	"	"*
6	"	"*	"	"	2 S.	"	"	"	"	"	"	"	0	"	"*
7	"	"*	"	"	0	"	"	"	"	"	"	"	"	"	- - -
8	"	"*	"	"	"	"	"	"	"	"	"	"	"	"	"
9	"	"*	"	"	"	"	"	"	"	"	"	"	"	"	0*
10	"	"*	"	"	"	"	"	"	"	"	"	"	"	"	2 N. E.*
11	"	"*	"	"	"	"	"	"	"	- - -	"	"	"	2 S. W.	1 N. E.*
Noon	"	"*	"	"	"	"	"	"	"	"	"	"	"	"	2 N.*
13	"	"*	"	"	"	"	"	"	- - -	0	"	"	"	3 S. W.	0
14	"	"	"	"	"	"	"	"	"	"	"	"	"	2 S. W.	"
15	"	"	"	"	"	"	"	"	"	"	"	"	"	1 S. W.	"
16	"	"	1 S.	"	"	"	"	"	"	"	"	"	"	"	"
17	"	"	1 S. E.	"	"	"	- - -	"	0	- - -	"	"	"	"	1 S.
18	"	"	1 N.	"	"	"	"	"	"	0	"	"	"	"	"
19	"	"	0	"	"	"	"	"	"	"	"	"	"	0	"
20	"	"	"	"	"	"	"	"	"	"	"	"	3 S.	"	"
21	"	"	"	"	1 S.	"	0	"	"	"	"	"	5 S.	1 S. W.	"
22	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
23	"	"	"	"	"	"	"	"	"	"	"	"	2 S.	1 S.	"
Midn't	"	"	"	"	"	"	"	"	1 S. W.	"	"	"	1 S.	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.
1h.	0	0	0	0	0	2 W.	2 N. W.	1 S.	0	0*	0	0	3 S.	3 S.	10 S. W.
2	"	"	2 S. E.	"	"	1 W.	3 N. W.	0	2 S. E.	"*	1 S. W.	"	1 S.	4 S.	9 S.
3	"	"	"	"	"	0	0	"	1 W.	"*	2 S. W.	"	"	5 S.	8 S. W.
4	"	"	3 E.	"	"	"	1 N. W.	"	0	"*	"	2 S.	"	"	9 S. W.
5	"	"	3 S. E.	"	"	"	3 S. E.	"	1 W.	"*	"	1 S.	2 S. W.	3 S.	7 S. W.
6	"	"	5 E.	"	"	"	"	"	0	"*	4 S. W.	1 S. W.	3 S. W.	2 S.	"
7	"	1 S. W.	4 S. E.	"	"	"	2 E.	"	2 S. W.	"*	3 S. W.	3 S. W.	"	5 S.	"
8	"	0	3 S. E.	1 S. E.	"	"	2 S. E.	"	1 S. W.	"*	4 S.*	4 S. W.	2 S. W.	"	5 S. W.
9	"	"	2 S. E.	2 S. E.	"	"	1 S. E.	"	"	"	3 S.	"	3 S. W.	4 S. W.*	7 S. W.
10	"	"	0	1 S. E.	"	"	"	"	1 E.	"	"*	5 S. W.	4 S. W.	5 S. W.*	"
11	"	"	"	"	"	1 W.	2 S. E.	"	0	"	2 S. W.*	3 S. W.	"	"*	"
Noon	"	"	"	"	- - -	0	4 S. E.	"	"	"	1 S. W.*	4 S. W.	2 S. W.	3 S. W.*	7 S.
13	"	"	"	"	"	"	3 S. E.	"	"	"	1 S.	5 S. W.	"	2 S. W.*	6 S. W.
14	"	"	"	"	"	"	2 S. E.	"	"	"	0	4 S. W.	"	"	5 S. W.
15	"	"	"	0	0	"	0	"	2 S. E.	"	"	4 S.	3 S. W.	2 S.	7 S. W.
16	"	"	"	"	"	"	"	"	1 S. E.*	1 W.	"	5 S.	2 S. W.	"	"
17	"	"	"	"	"	"	"	"	1 E.*	0	"	4 S. W.	3 S. W.	"	5 S. W.
18	"	"	"	2 S. E.	"	"	"	"	0*	"*	"	5 S. W.	2 S. W.	3 S.	"
19	"	1 N. E.	"	"	"	"	"	"	"*	"*	"	"	"	"	3 S. W.
20	"	"	"	0	"	"	"	1 S. W.	"	2 S.*	"	"	1 S. W.	4 S.	5 S.
21	"	"	2 S. E.	"	"	"	"	- - -	"*	3 S.*	"	"	4 S. E.	"	3 S. E.
22	"	"	"	"	"	"	"	"	"*	4 S.*	"*	"	5 S.	5 S.	"
23	"	"	"	"	"	"	"	"	"*	3 S.*	2 S. E.*	3 S.	6 S.	5 S. E.	"
Midn't	"	"	"	"	"	2 N. W.	"	"	"*	2 S.*	"*	"	5 S.	5 S.	"

* Snow.

Sept. 30th. From 12 to 2 A. M., heavy drift and wind squall.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In October, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	2 S.	2 S. W.	6 S. W.	3 N. E.	0	2 N. E.	2 N. W.	0*	3 S. W.	0	1 W.	0	2 W.	4 W.	9 S. E.
2	"	5 S. W.	1 S.	2 N. E.	"	"	"	"*	"	"	2 S. W.	"	"	"	8 S.
3	0	6 S. W.	0	3 S. W.	"	2 N. W.*	2 N.	"	"	"	1 S. W.	"	0	3 N. W.	"
4	"	1 S. W.	"	"	"	"*	1 N.	"	"	"	"	"	"	"	6 S.
5	2 S. W.	4 S. W.	"	"	2 S.	2 W.*	0	"	2 W.	"	0	"	2 S. W.*	2 N. W.	4 S. W.
6	1 S. W.	3 S. W.	1 S. W.	"	1 S. W.	2 N. W.*	"	"	3 S. W.	"	"	"	"*	"	4 S.
7	1 S.	1 N.	0	"	1 S.	"*	3 S. W.	2 S.*	1 S.	"	"	1 S. W.	3 S. W.	1 N. W.*	4 S. W.
8	"	"	"	4 S. W.	0	"*	"	1 S.*	7 S.	"	"	"	2 S. W.	"*	4 S.
9	"	3 W.	"	3 S. W.	"	0*	4 S. W.	"	3 S. W.	"	"	"	3 S. W.	2 W.*	3 S. W.
10	"	4 S. W.	2 S. W.	0	"	"*	5 S. W.	"	1 S. W.	"	"	"	4 S. W.	"*	3 S.
11	"	5 S.	"	1 S. W.	"	"	"	"	0	"	"	1 S. E.	"	3 N. W.	1 S.
Noon	0	"	2 S.	2 S. W.	"	"	5 S.	"	"	"	"	"	"	"	0
13	"	2 S.	0	"	1 S.	"	4 S.	1 S. W.	"	"	"	0	"	"	2 S. W.
14	"	3 S. W.	2 S. W.	"	0	"	4 S. W.	"	"	"	"	"	"	2 N. W.	2 S.
15	"	3 S.	3 S. W.	0	"	"	3 S. W.	"	"*	"	"	"	3 S. W.	2 S.	3 S. W.
16	"	"	"*	"	"	"	1 S. W.	"	"	"	"	"	2 S. W.	1 S.	2 S. W.
17	"	2 S. W.	1 S. W.	1 N. W.	"	"	"	2 S.	"	"	"	"	3 S. W.	"	"
18	"	3 S. W.	"	0	"	"	"	1 S.	"	"	"	1 S. W.	1 S. W.	"	"
19	"	1 S. W.	0	1 N. W.	"	"	2 S. W.	"	"	"	1 W.	"	0	"	3 S. W.
20	"	"	"	"	"	"	2 S.	2 S.*	"	"	"	"*	"	"	"
21	"	5 S. W.	3 S. W.	2 N. W.	"	2 N. W.	3 S. W.*	"	"	"	2 W.	0*	2 N. W.	"	5 S. W.
22	"	6 S. W.	"	0	"	"	1 S. W.*	1 S.	"	"	"	"*	2 W.	"	"
23	4 S. W.	6 S.	4 S. W.	2 S. W.	3 N. W.*	3 N. W.*	"*	"	"	"	3 W.	"	"	3 S.	6 S.
Midn't	3 S. W.	"	"	"	3 W.*	"*	0*	"	"	"	2 S. W.	"	"	5 S.	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	5 W.	0	0	1 S. E.	0	0	- - -	- - -	1 N.	1 S.	- - -	0	1 S.	0	1 S. W.	- - -
2	6 S. W.	"	"	0	"	"	"	"	"	"	"	1 S. E.	"	"	1 S.	"
3	4 W.	"	"	"	"	"	0	0	0	0	1 S. W.	0	"	"	3 S. W.	"
4	6 W.	"	"	"	"	"	"	"	"	"	"	"	"	1 S.	"	"
5	4 W.	"	"	"*	"	"	1 S. E.	"	"	"	- - -	"	0	"	2 S. W.	1 S. W.*
6	"	"	"	"	"	"	"	"	"	"	"	"	1 S.	"	"	0*
7	0	1 S.	"	"	"	"	0	"	"	1 S. W.	0	"	0	0	0	"*
8	1 E.	"	"	"	"	"	"	"	"	2 S. W.	"	"	"	"	"	"*
9	1 S.	"	"	"*	"	"	"	"	"	1 S. W.	"	"	"	"	"	"
10	2 S.	0	"	"	"	"	"	"	1 S. E.	"	"	"	"	1 S. E.	1 S. W.	"
11	2 S. W.	"	"	"	"	"	"	"	"	0	"	"	2 S.	"	"	- - -
Noon	0	"	"	"	"	"	"	"	"	"	1 N. E.	"	"	"	"	"
13	"	"	"	"	"	"	"	"	0	"	1 S. E.	"	1 S. E.	1 S.	"	"
14	"	"	"	"	"	"	"	"	"	"	"	"	1 S.	"	"	"
15	"	"	"	"	"	"	1 S. E.	"	"	"	0	"	1 S. E.	- - -	"	1 S.
16	"	"	"	"	"	"	"	"	"	"	"	"	1 E.	"	"	"
17	"	"	"	"	"	"	0	"	"	1 S. E.	"	"	"	"	"	0
18	"	"	"	"	"	"	"	"	1 S. E.	"	"	"	"	"	"	"
19	"	"	"	"	"	"	"	"	"	"	"	1 S. W.	0	"	0	"
20	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
21	"	"	"	"*	"	"	"	"	"	2 S. E.	"	"	"	"	"	"
22	"	"	"	"*	"	"	"	"	0	"	"	"	"	"	"	"
23	"	1 S. W.	"	2 S. W.	"	"	"	"	"	"	"	1 S.	"	0	"	"
Midn't	"	2 S. W.	"	1 S. W.	"	"	"	"	"	1 S. E.	"	"	"	"	"	"

* Snow.

October 15th. From 12 to 2 A. M., the wind blowing a heavy gale (9) from the S. S. E.

DIRECTION AND FORCE OF THE WIND observed at VAN RENSSELAER HARBOR,
In November, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.
The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0	0	0	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0	0	0	0	0
2	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
3	"	"	"	"	"	"	"	"	"	"	"	1 N.	"	"	"
4	1 S.	"	"	"	"	"	"	"	"	"	"	0	"	"	"
5	0	"	"	"	"	"	"	"	"	"	3 N.	"	"	1 S. W.	"
6	"	"	1 W.	"	"	"	"	"	"	"	2 N.	"	"	"	"
7	1 S.	"	"	"	"	"	"	"	"	"	1 N.	"	"	2 S. W.	"
8	2 S.	"	0	"	"	"	"	"	"	"	"	"	"	1 S. W.	"
9	4 S.	"	"	"	"	"	"	"	"	"	0	"	"	0	"
10	3 S.	"	"	"	"	"	"	"	"	"	"	"	"	"	"
11	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Noon	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
13	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
14	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
15	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
16	0	"	"	"	"	"	"	"	"	"	"	"	"	"	"
17	"	"	"	"	"	"	"	"	"	"	- - -	1 N.	"	"	"
18	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
19	"	"	"	"	"	"	"	"	"	"	0	0	"	"	"
20	1 S.	"	"	"	"	"	"	"	"	"	"	"	"	"	"
21	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
22	0	"	"	"	"	"	"	"	"	"	"	"	"	"	"
23	1 W.	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Midn't	0	"	"	"	"	"	"	"	"	"	"	"	"	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.
1h.	0	0	2 S. E.	0*	7 S. W.	0	0	0	0	0	2 N. E.	1 S.	0	1 N. W.	0
2	"	"	0	"*	8 S. W.	"	"	"	"	"	"	"	1 S. E.	0	"
3	1 N.	"	1 S. E.	3 S. W.*	7 S. W.	"	"	"	"*	"	2 S.	"	1 N. E.	3 S. W.	"
4	"	"	1 W.	2 S. W.*	8 S. W.	"	"	"	"*	"	3 S. E.	1 S. W.	2 N. W.	2 S. W.	"
5	0	"	- - -	1 S. W.*	"	1 S. W.	"*	"	"*	"	3 S.	0	"	1 E.	"
6	"	"	"	1 S. W.*	9 S. W.	0	"*	"	"*	1 S.	4 S.	"	2 S. W.	2 E.	"
7	"	"	0	0*	"	"	"*	"	1 W.	"	5 S.	"	0	0	"
8	"	"	"	"*	8 S. W.	"	"*	"	3 W.	2 S.	3 S.	"	"	"	1 N. W.
9	"	"	1 S. E.	"	9 S. W.	"	1 W.*	"	2 S.	3 S. W.	0	1 W.	1 S. E.	"	0
10	"	"	3 S. E.	"	"	"	"*	"	1 S.	4 S. W.	"	"	"	"	"
11	"	"	0	"	0	1 S.	0*	1 N. E.	2 S.	5 S.	"	0*	0	"	"
Noon	"	"	1 E.	"	"	0	"*	0	0	4 S.	"	"*	"	"	"
13	"	"	5 S. E.	2 S. E.	1 S.	1 S. E.	"*	2 N. E.	"	3 E.	"	1 S.	2 S. W.	"	"
14	"	"	1 S. E.	3 S.	2 S.	0	"*	"	"	"	"	0	0	"	1 N. W.
15	"	"	1 S.	1 N. W.	0	"	"*	2 S. W.	"	0	"	"	"	"	0
16	"	"	3 S.	2 N. W.	"	1 N.	"*	3 S. W.	"	"	"*	"	"	"	"
17	1 N. W.	"	0	1 S. W.	"	0	"	2 S. W.	"	"	"	"	"	"	"
18	"	"	"	3 S. W.	"	"	"	"	1 N.	"	"	"	"	"	"
19	0	"	"	2 S. W.	"	"	"	"*	0*	"	"	"	"	"	"
20	"	"	"	3 S. W.	"	"	"	"*	"	"*	1 S.	"	"	"	"
21	"	"	"	2 S. E.	3 S.	"	"	0*	"	"	2 S.	"	"	"	"
22	"	"	1 E.	0	"	"	"	"	"	"	"	"	"	"	"
23	"	"	"	4 S.	"	1 W.	1 N.	2 S. W.*	1 S. W.*	2 S. W.	3 S.	"	"	1 S.	"
Midn't	"	"	"	5 S.	2 S.	"	"	1 S. W.	"*	"	"	"	1 E.	"	"

* Snowing.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In December, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
1h.	0	0	0	0	0	0	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0	0
2	"	"	"	"	"	"	"	"	"	"	"	"	0	1 W.	"
3	"	"	1 S. W.	"	"	"	0	"	0	"	3 S. W.	0	"	0	"
4	"	1 S. E.	2 S. W.	"	"	"	"	"	"	"	2 S. W.	"	1 W.	"	"
5	"	"	"	1 W.	3 S. E.	"	"	0	- - -	"	0	1 S. W.	0	1 E.	"
6	2 W.*	"	3 S. W.	"	1 S. W.	"	"	"	"	"	"	1 W.	"	0	"
7	"	"	5 S. W.	0	0	"	1 S.	"	0	1 N.	"	"	"	"	"
8	1 W.	"	1 S. W.	"	"	"	"	"	"	"	"	1 S. W.	"	"	"
9	0	"	"	"	"	"	3 S. W.	1 W.	1 W.	2 N.	2 S. E.	"	"	"	"
10	"	1 N.	"	"	"	"	4 S. W.	0	1 S.	"	3 S. E.	1 S.	"	"	"
11	"	0	3 S.	"	"	"	0	"	"	"	0	3 S.	"	"	"
Noon	"	"	1 S.	"	"	"	"	"	2 S.	"	"	5 S. W.	"	"	"
13	"	"	2 S. W.	"	"	"	"	"	0	0	"	0	"	"	"
14	"	1 N.	3 S. W.	"	"	"	"	"	"	"	"	"	"	"	"
15	"	0	2 S. W.	"	"	"	1 W.	"	"	"	1 S. E.	2 S.	"	"	"
16	"	"	4 S. W.	"	"	"	1 S.	"	"	"	0	0	"	"	"
17	"	"	6 S. W.	"	"	"	0	"	"	"	"	"	"	"	"
18	"	"	4 S. W.	"	"	"	"	"	"	3 S. E.	"	"	"	"	1 W.
19	"	"	3 S. W.	"	"	"	"	"	"	1 S.	"	"	"	"	0
20	"	"	0	"	"	"	"	"	1 S.	"	"	"	"	"	"
21	"	"	"	"	"	"	- - -	"	0	4 S.	"	4 W.	"	"	- - -
22	2 N. W.	"	"	"*	"	"	"	"	"	5 S.	"	0	"	"	"
23	4 N. W.	1 S.	1 S. W.	"	"	"	"	"	- - -	- - -	- - -	- - -	"	"	"
Midn't	0	0	"	"	"	"	"	"	"	"	"	"	"	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	0	0	0	6 S. E.	5 S. W.	1 S.	0	0	- - -	0	0	0	0	0	3 S.	0
2	"	"	"	1 N.	4 S.	2 S.	"	"	0	- - -	"	"	1 W.	"	2 S. W.	"
3	"	"	"	0	2 S. W.	0	"	- - -	"	0	3 E.	"	0	2 S. E.	0	"
4	"	1 W.	"	"	1 S.	"*	"	0	"	"	1 N. E.	"	"	0	"	"
5	"	0	"	2 S. E.	2 S. E.	"*	"	"	"	"	0	"	"	"	"	"
6	"	1 E.	"	1 S. E.	0	"*	"	"	"	"	"	"	"	"	"	"
7	"	"	"	"	"	"*	"	"	"	"	"	"	"	"	"	5 S. W.
8	"	"	"	"	"	"*	"	"	"	2 S. W.	"	"	"	"	"	4 S.
9	"	"	"	0	"	"*	"	"	"	3 S. W.	"	"	"	3 E.	"	5 S. W.
10	"	"	1 S.	"	"	"	"	"	"	4 S. W.	"	"	"	4 E.	"	7 S.
11	"	"	0	1 N.	"	2 S.	"	"	"	3 S. W.	"	"	"	"	"	4 S. W.
Noon	"	1 S.	"	"	"	3 S. W.	"	"	"	0	"	"	"	5 S. E.	"	7 S.
13	"	0	"	"	"	0	"	"	"	"	"	"	"	4 S. E.	"	0
14	"	"	"	"	"	3 S. E.	"	"	"	2 S.	"	"	"	2 S. E.	"	"
15	"	"	9 S. E.	"	"	5 S. E.	"	"	2 S. W.	1 S.	"	"	3 S.	"	"	"
16	"	"	"	"	"	3 S. E.	"	1 S. E.	"	1 S. W.	"	"	5 S. W.	3 S.	"	"
17	"	"	8 S. E.	"	1 E.	2 S. E.	"	"	1 W.	"	"	"	6 S.	1 S.	"	4 S.
18	"	"	"	"	"	"	"	"	1 N.	2 S. W.	"	"	3 S. W.	0	"	3 S.
19	"	"	7 S. E.	"	0	3 S. E.	"	0	0	1 S. W.	"	"	2 S.	"	"	1 S.
20	"	"	5 S. E.	"	"	0	"	"	"	0	"	"	4 S. W.	"	"	0
21	"	"	3 S. E.	- - -	"	- - -	"	- - -	"	"	"	"	0	3 S.	"	2 S.
22	1 E.	"	1 S. E.	"	"	5 S. E.	"	0	"	"	"	"	"	4 S. W.	"	1 S. W.
23	0	"	0	"	"	4 S. E.	"	"	"	"	"	"	"	5 S.	"	2 S.
Midn't	"	"	"	"	"	0	"	"	"	"	"	"	"	2 S. W.	"	0

* Snow.

DIRECTION AND FORCE OF THE WIND OBSERVED AT VAN RENSSELAER HARBOR,

In January, 1855, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

The directions are magnetic. Variation of compass 108° W.

Hour.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th	14th.	15th.
1h.	2 W.	0	0	0	- - -	- - -	- - -	0	1 S. E.	1 S.	0	0	0*	1 S. W.	0
2	1 W.	"	"	"	0	"	"	"	"	- - -	"	"	"*	"	"
3	"	"	"	"	"	2 S. E.	1 S. W.	"	0	0	"	"	"*	2 S. W.	"
4	0	"	1 W.	"	"	"	"	"	"	"	"	"	"*	"	"
5	"	"	0	"	"	1 S. E.	"	"	"	"	"	"	"*	1 S. W.	"
6	"	"	"	"	"	0	"	"	"	"	"	"	"*	0	"
7	"	"	"	"	"	"	"	"	"	"	"	"	"*	"	"
8	"	"	"	"	"	"	"	"	"	"	1 S. W.	"	2 S. W.*	"	2 W.
9	"	"	"	"	"	2 N. W.	"	"	"	"	1 S.	1 S. E.	"*	1 S. W.	1 W.
10	"	"	"	"	"	1 N. W.	"	"	"	"	2 S. W.	2 S. E.	4 S. W.*	"	2 S. W.
11	"	"	"	"	"	2 N. W.	"	"	"	"	2 S.	"	7 S. W.*	"	"
Noon	"	"	"	"	"	3 N. W.	"	"	"	"	4 S. W.	1 S. E.	6 S. W.	"	3 S. W.
13	"	"	"	"	1 W.	2 N. W.	"	"	"	"	3 S.	0	5 S. W.	"	4 S. W.
14	"	"	"	"	"	"	"	1 W.	"	"	1 S. W.	"	"	0	3 S. W.
15	"	"	1 N.	"	1 N. W.	0	"	0	"	1 E.	0	"	2 S. W.	"	0
16	"	"	2 N. W.	"	0	"	"	"	"	0	"	"	0	"	2 S.
17	"	"	0	1 S.	"	"	"	"	"	"	"	"	"	"	3 S. W.
18	"	"	"	2 S. W.	"	"	"	"	"	"	"	"	"	"	3 S.
19	"	"	"	0	"	"	"	"	"	"	"	"	2 S. E.	"	2 S. W.
20	"	"	"	"	1 S.	"	"	"	1 S.	"	"	"	1 S. E.	"	0
21	"	"	"	"	1 S. E.	1 var.	"	"	0	"	"	"	3 S. E.	- - -	- - -
22	"	"	"	"	3 S. E.	- - -	"	"	"	1 var.	"	"	9 S. E.	"	"
23	"	"	"	"	2 S. E.	1 S. W.	"	"	2 S.	"	"	1 var.	10 S. E.	"	"
Midn't	"	"	"	1 S. W.	1 S. E.	"	"	1 N.	1 W.	"	"	2 N. W.*	9 S. E.	"	"

Hour.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	31st.
1h.	0	0	0	8 S. W.	2 S. W.	1 W.	2 S. W.	0	0*							
2	"	"	1 W.	7 S. W.	1 W.	0	"	"	"*							
3	"	"	2 S. W.	6 S.	1 S. E.	"	0	1 S. E.	"*							
4	"	"	1 S. W.	6 S. W.	"	1 S.	"	"	"*							
5	"	"	- - -	- - -	- - -	- - -	- - -	- - -	"*							
6	"	1 S. W.	"	"	"	"	"	"	"*							
7	2 N. W.	0	3 S. E.	5 S. W.	"	"	"	"	"*							
8	1 N. W.	"	2 S. E.	6 S. W.	"	"	"	"	"*							
9	1 N.	1 W.	"	3 S.	1 S. E.	2 S.	0	1 S. E.	1 S. E.*							
10	"	2 W.	"	2 S.	"	3 S.	"	"	"*							
11	"	4 S. W.	1 S. E.	"	"	"	"	"	"*							
Noon	"	5 S. W.	"	1 S.	"	"	"	"	"*							
13	- - -	- - -	- - -	- - -	- - -	- - -	- - -	"	0*							
14	"	"	"	"	"	"	"	"	"*							
15	"	"	"	"	"	"	"	"	"*							
16	"	"	"	"	"	"	"	"	"*							
17	"	"	7 S. W.	1 S. W.	2 S. W.	2 S. W.	0	"	- - -							
18	"	"	8 S. W.	"	"	2 W.	"	"	"							
19	1 N.	"	5 S. W.	- - -	- - -	- - -	- - -	- - -	"							
20	"	"	2 S. W.	"	"	"	"	"	"							
21	0*	0	- - -	"	"	"	"	1 S. E.	"							
22	"	"*	"	1 S. E.	"	"	"	"	"							
23	"	"	"	"	"	"	"	"*	"							
Midn't	- - -	"	"	5 S. E.	"	"	"	"	"							

* Snow.

January 17th. From 10h. to 12h., blowing hard from S. W., with thick snow drift.

The immediate bearing of the wind on the temperature, the weight and moisture of the atmosphere, and upon the climate in general, as well as its practical relation to navigation, renders this meteorological element of equal importance with any of the others, though it has, perhaps, received comparatively less attention.

Method of Reduction.—In the following discussion, we have to consider the average direction and force, as well as the quantity of air blown over the place of observation.

In regard to the mean direction and velocity of the wind for any given period—a day, month, or year—the customary formula of Lambert has been so far modified as to include the velocity, and not to depend on the relative frequency of the winds alone.

Let $\theta_1\ \theta_2\ \theta_3 \ldots\ldots$ be the angles which the directions of the wind make with the meridian, reckoned round the compass, according to astronomical usage, from the south, westwards to 360°, or in a direction indicated by the law of rotation; and $v_1\ v_2\ v_3 \ldots\ldots$ its respective velocities, which may be supposed expressed in miles per hour; and let the observations be made at equal intervals of time, say hourly. By adding up all velocity-numbers referring to the same wind during a given period, and representing these quantities, or the number of miles of air transferred bodily over the place in each direction, by $s_1\ s_2\ s_3 \ldots\ldots$, then the quantity of air passed over the place of observation by winds *from* the southward is expressed by

$$R_s = s_1 \cos\theta_1 + s_2 \cos\theta_2 + s_3 \cos\theta_3 + \ldots\ldots$$

And for winds *from* the westward

$$R_w = s_1 \sin\theta_1 + s_2 \sin\theta_2 + s_3 \sin\theta_3 + \ldots\ldots$$

The resulting quantity R, and the angle ϕ it forms with the meridian, is found by the expressions

$$R = \sqrt{R_s^2 + R_w^2}, \text{ and } \tan\phi = \frac{R_w}{R_s}.$$

The general formulæ, in the case of eight principal directions θ, assume the convenient form

$$R_s = (S—N) + (SW—NE)\sqrt{\tfrac{1}{2}} — (NW—SE)\sqrt{\tfrac{1}{2}}$$
$$R_w = (W—E) + (SW—NE)\sqrt{\tfrac{1}{2}} + (NW—SE)\sqrt{\tfrac{1}{2}}$$

Where the letters S, SW, W, etc., stand for the sum of all velocities during the given period, or for the quantity of air moved in the directions S, SW, W, etc., respectively; R_s stands for the total quantity of air transported *to* the northward, and R_w for the same transferred *to* the eastward. These formulæ, for practical working, may be put in the following shape:—

Put $S—N = a$ $\qquad$ $SW—NE = c$
$\qquad\ W—E = b$ $\qquad$ $NW—SE = d$

Then

$$R_s = R\cos\phi = a + 0.707\ (c—d)$$
$$R_w = R\sin\phi = b + 0.707\ (c+d).$$

Since R_s, R_w, R, represents the quantity of air passed over during the given period in the direction 0, 90°, ϕ, respectively, we must, in order to find the mean

velocity in any resulting direction, divide by n, or the number of observations during that period; we then have

$$V_s = \frac{R_s}{n}, \quad V_w = \frac{R_w}{n}, \quad \text{and } V = \frac{R}{n}.$$

A particle of air which has left the place of observation at the commencement of the period—of a day, for instance—will be found at its close in a direction $180 + \phi$, and at a distance of R miles, equal to a movement with an average velocity of $\frac{R}{n}$; the length of the path described by the particle can be found by the summation of all the v's (for each hour) during the period.

The above development supposes that all particles of the air surrounding the station equally participate in the general motion, or that all particles describe equal and parallel paths.

To admit nothing arbitrary in the reduction, no attempt has been made to interpolate values in those instances where occasional omissions occur in the hourly abstract.

The great variability in the direction and force of the aerial motion renders the taking of mean values for short intervals unnecessary, and we can at once proceed to the mean monthly values.

For the convenience of reference, and in illustration of the method of reduction, one of the monthly abstracts of the sum of the velocity numbers of each wind is here inserted. Similar abstracts were made for each of the seventeen months during which the observations continued.

ABSTRACT OF THE QUANTITY OF WIND IN EACH OF THE EIGHT PRINCIPAL DIRECTIONS, OBSERVED AT VAN RENSSELAER HARBOR,

In September, 1858.

MAGNETIC DIRECTION.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.	
S.	0	0	0	- - -	0	0	0	0	13	0	0	0	0	1	0	...
N.	92	102	0	- - -	0	0	0	0	36	0	0	36	0	2	13	...
W.	92	0	0	- - -	0	0	0	0	17	40	9	16	0	0	0	...
E.	0	0	0	- - -	0	0	22	0	0	0	0	0	0	3	66	...
S. W.	0	0	0	- - -	0	413	214	0	4	0	0	0	0	0	0	...
N. E.	0	0	0	- - -	0	0	0	15	0	0	0	0	0	3	0	...
N. W.	199	217	19	- - -	5	0	1	13	46	0	0	0	0	0	0	...
S. E.	0	0	0	- - -	0	0	0	0	0	0	0	4	0	2	0	...
Sum & check	383	319	19	- - -	5	413	237	28	116	40	9	56	0	11	79	...

MAGNETIC DIRECTION.	16th.	17th.	18th.	19th.	20th.	21st.	22d.	23d.	24th.	25th.	26th.	27th.	28th.	29th.	30th.	Sums.
S.	0	0	4	0	0	4	40	53	0	11	0	13	2	0	2	143
N.	2	0	0	0	5	0	0	0	0	0	0	0	112	49	0	449
W.	0	5	0	1	0	0	0	0	0	0	0	31	4	0	5	220
E.	0	0	0	8	0	0	0	0	0	0	0	4	0	0	1	104
S. W.	0	0	0	0	0	105	14	50	7	52	4	0	5	0	7	875
N. E.	5	0	0	5	0	0	0	0	0	0	0	6	0	0	2	36
N. W.	0	5	1	0	23	0	0	0	0	0	0	0	6	25	0	560
S. E.	0	0	0	0	0	0	34	0	13	0	41	20	25	0	4	143
Sum & check	7	10	5	14	28	109	88	103	20	63	45	74	154	74	21	2530

Resulting Monthly Direction of the Wind.—The resulting monthly direction ϕ of the wind is obtained by adding up the velocity-numbers for each wind separately, from the hourly observations taken during the month, irrespective of omissions. The numbers thus obtained are then treated in accordance with the preceding formulæ. For the month of September, 1853, for instance, we would have—

Σ S. $= 143$	Hence $c = +839$	$R_s = -11$
Σ N. $= 449$	$d = +417$	$R_w = +995$
Σ W. $= 220$	$c - d = +422$	$R = 995$
Σ E. $= 104$	$c + d = +1256$	$\phi = 89° 22'$
Σ S. W. $= 875$	$0.7\ (c - d) = +295$	equivalent to a
Σ N. E. $= 36$	$0.7\ (c + d) = +879$	west wind.
Σ N. W. $= 560$	$a = -306$	
Σ S. E. $= 143$	$C = +116$	

To convert the resulting ϕ from the magnetic into the true direction, apply the magnetic declination, viz: 108° 12′ west.[1]

In like manner, the mean direction of the wind for each month has been made out. The following table exhibits the sum of the velocity-numbers for each wind, as well as the resulting direction of the winds for each month of observation:—

Direction.	1853.				1854.				
	September.	October.	November.	December.	January.	February.	March.	April.	May.
S.	143	1069	197	532	176	735	464	463	668
N.	449	47	39	5	52	16	2	48	164
W.	220	18	12	290	100	23	61	5	9
E.	104	47	35	233	6	254	46	3	9
S. W.	875	413	219	348	158	733	26	1187	730
N. E.	36	1	54	107	17	1	2	0	0
N. W.	560	408	90	132	38	25	154	68	251
S. E.	143	1102	763	1718	326	838	243	300	249
Magnetic ϕ	89°	353°	333°	334°	359°	351°	357°	25°	27°
True ϕ	341	245	225	226	251	243	249	277	279

Direction.	1854.							1855.
	June.	July.	August.	September.	October.	November.	December.	January.
S.	0	381	776	897	726	436	437	123
N.	229	50	89	5	9	28	27	8
W.	108	88	106	9	273	24	45	28
E.	0	10	28	51	4	36	82	1
S. W.	308	832	16	1505	1297	888	572	792
N. E.	157	18	9	11	26	18	1	0
N. W.	1163	261	397	23	165	18	27	44
S. E.	0	38	527	296	109	77	661	365
Magnetic ϕ	132°	47°	359°	21°	37°	27°	356°	22°
True ϕ	24	299	251	273	289	279	248	274

To obtain the resulting direction of the wind in each month, each season, and for the whole year, we first take the mean of the values R_s and R_w respectively, for the same months in the different years and find—

[1] See my discussion of Dr. Kane's magnetical observations, in Vol. X. of the Smithsonian Contributions to Knowledge, 1858, p. 25.

Month.	R_s.	R_w.	Mag. φ.	True φ.	Month.	R_s.	R_w.	Mag. φ.	True φ.
September	+1059	+904	40°	292°	March	+ 541	— 30	357°	249°
October	+1682	+486	17	269	April	+1408	+ 670	25	277
November	+ 901	+ 89	6	258	May	+1014	+ 512	27	279
December	+1530	—482	342	234	June	— 937	+1027	132	24
January	+ 659	+174	15	267	July	+ 745	+ 805	47	299
February	+1800	—288	351	243	August	+ 783	— 8	359	251

By means of ΣR_s and ΣR_w for the respective periods, we find the following mean directions:—

	Magnetic φ.	True φ.	True direction.
Winter (December, January, February)	351°	243°	E. 27° N.
Spring (March, April, May)	21	273	E. 3 S.
Summer (June, July, August)	72	324	E. 54 S.
Autumn (September, October, November)	22	274	E. 4 S.
Year	19	271	E. 1 S.

From the above results we see that, in general, the mean *true* direction of the wind is from the eastward, varying in the several months to the northward and southward of it. There is but one exception, namely: in the month of June, the wind veers round to the westward of south. In spring and autumn, the resulting *true* direction is almost exactly east, as well as for the whole year; in winter it is E. N. E., and in summer S. E. by S.

Average Velocity in the Mean Direction of the Wind.—The average velocity in the mean direction of the wind—or, in other words, the mean velocity of the resulting wind—which is necessarily smaller than the mean velocity of the several winds on account of the neutralization by opposing winds, is found by dividing the quantity R by the actual number of observations (exclusive of calms). Thus, for September, 1853, we found $R = 995$, n the number of hours of observations = 348, hence $V = 2.9$ miles per hour. In similar manner, V has been found for each month of the year. In the table below, the quantities opposite the months from September to January inclusive, are mean values derived from the years 1853 and 1854, and 1854 and 1855.

Table of the Mean Velocity of the Resulting Wind.

Month.	R	n	V	Month.	R	n	V
September	1637	278	5.9	March	541	262	2.1
October	1892	377	5.0	April	1559	385	4.0
November	1016	213	4.8	May	1136	441	2.6
December	1633	213	7.7	June	1390	257	5.4
January	694	256	2.7	July	1097	200	5.5
February	1823	332	5.5	August	783	244	3.2

Average V for the whole year . . . . . 4.5 miles per hour.

Having found the resulting direction of the wind and its mean velocity in this direction, we proceed to determine the mean velocity of each wind.

Mean Velocity of the Winds.—The average velocity with which each of the eight winds passes over the place of observation in each month and for the whole year, is found by dividing the sum of their velocity-numbers in the period by their respective number of entries in the table; thus, for the month of September, 1853, we have:—

Direction (Magnetic).	Sum of velocities.	Number of entries.	Mean velocity.	Direction (Magnetic).	Sum of velocities.	Number of entries.	Mean velocity.
S.	143	40	3.6	N. E.	36	15	2.4
S. W.	875	88	10.0	E.	104	25	4.2
W.	220	35	6.3	S. E.	143	38	3.8
N. W.	560	55	10.2				
N.	449	52	8.6	Sums and mean	2530	348	7.3

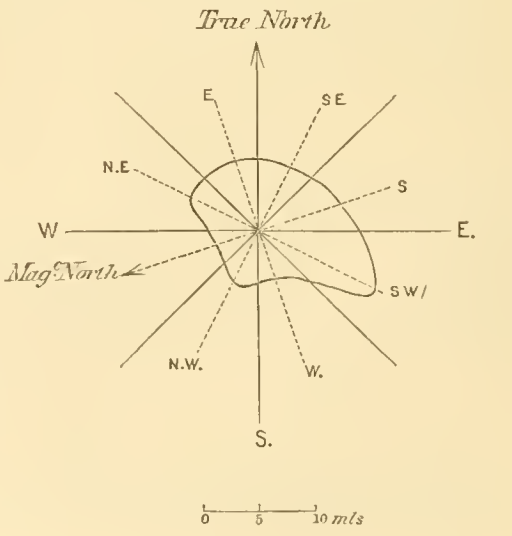
In the following table of the mean velocity of the winds, the values for September, October, November, December, and January are mean values. As in the above example, the weighted means are given in the table.

Magnetic Direction.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
S.	2.9	9.4	4.3	3.3	10.9	- - -	18.1	12.1	10.1	8.2	6.3	9.1
S. W.	8.2	11.3	1.5	14.6	7.1	8.7	23.1	1.6	14.2	9.2	15.6	11.5
W.	3.2	2.1	2.0	1.0	1.0	4.3	2.9	6.3	5.6	10.4	1.5	7.0
N. W.	2.7	1.5	6.4	1.5	1.6	6.8	4.1	7.2	9.7	10.4	4.2	3.6
N.	1.7	2.3	1.0	1.3	2.2	11.4	1.7	3.6	8.4	3.3	2.6	2.0
N. E.	1.6	1.0	1.0	- - -	- - -	22.4	4.5	3.0	2.0	4.5	4.8	7.2
E.	1.0	8.5	11.5	1.0	1.5	- - -	2.5	2.8	5.1	2.1	3.5	13.1
S. E.	4.3	6.7	3.3	4.1	6.9	- - -	2.9	8.8	5.7	5.5	5.8	11.1
Weighted mean	4.4	7.9	3.8	5.4	4.7	7.6	8.4	8.0	9.6	7.6	6.9	9.5

The winds, therefore, blow with their greatest strength in the months of September and December, and with their least strength in the months of March and May; in the former the mean velocity is 9.6, and in the latter case 4.2 miles per hour. In the following table is exhibited the mean velocity of each wind separately:—

Magnetic direction.	Mean velocity in miles per hour.
S.	7.4
S. W.	11.2
W.	4.1
N. W.	4.8
N.	3.5
N. E.	6.2
E.	6.0
S. E.	6.3

Of all winds, the S. W. (magnetic) blows with the greatest force, and the north wind with the least. The relation of the velocity of the wind to its direction is further illustrated by the annexed diagram.



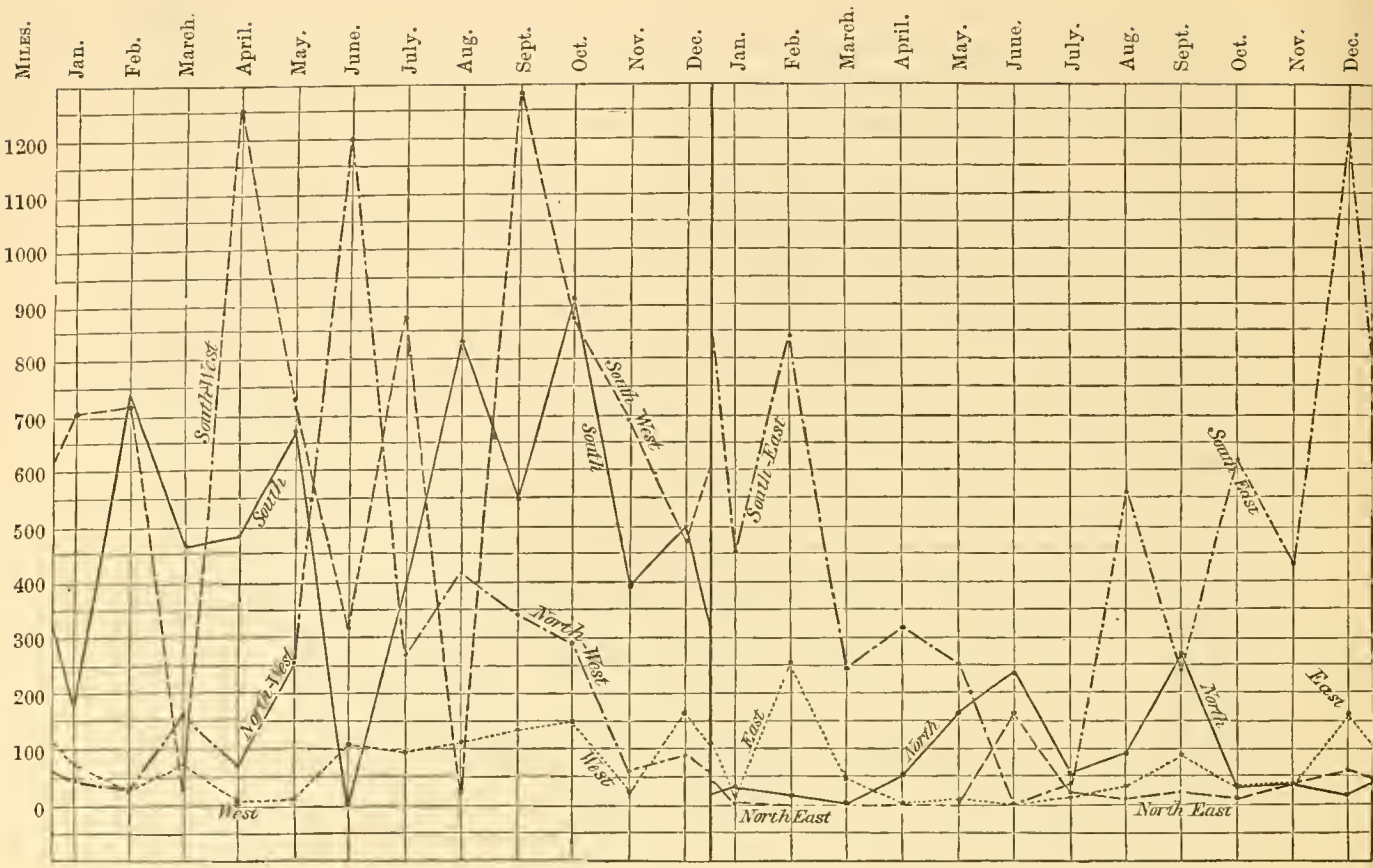
Quantity and Relative Frequency of the Winds.—The sum of the velocity-numbers, or the number of miles travelled over by the air in any direction for any given period, may be called the quantity (q) of the wind which has been transferred over the place of observation during that time. It will not be necessary to take into account the variations in the density of the air, and the number given below refers, therefore, to an average density. The velocity-numbers for each wind and month have been given in a preceding table; they require, however, a correction, in order to find q, for the occasional omissions in the observations. Thus, in September, 1853, no observations were recorded during 109 hours, and we may assume that during this time the several winds (inclusive of calms) occurred, or would have occurred in quantity and with a frequency directly proportional to their numbers found from the 720 — 109 remaining hours of the month. After adding this proportional number for each wind and month, and after taking mean values for the same months, the following table of the quantity of wind (q) has been made out.

Magnetic Direction.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yr. mls.
S.	187	735	464	488	668	0	402	830	545	918	385	497	6119
S. W.	713	733	26	1250	730	317	877	17	1291	880	693	477	8004
W.	72	23	61	5	9	111	93	113	134	150	22	169	962
N. W.	54	25	154	71	251	1197	275	425	342	293	57	81	3225
N.	33	16	2	51	164	236	53	95	267	28	38	17	1000
N. E.	9	1	2	0	0	162	19	10	27	14	39	54	337
E.	4	254	46	3	9	0	11	30	88	26	41	160	672
S. E.	455	838	243	316	249	0	40	564	236	616	433	1210	5200
Sums	1527	2625	998	2184	2080	2023	1770	2084	2930	2925	1708	2665	25519

The following table gives the number of hours during which each wind blew, or the relative frequency of each wind for every month.

Magnetic Direction.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yr. hrs.
S.	58	78	108	146	61	0	22	68	56	112	57	55	821
S. W.	81	65	17	85	103	36	38	11	93	95	42	42	708
W.	24	11	31	5	9	26	32	18	24	15	14	24	233
N. W.	19	16	24	50	152	175	67	59	34	28	14	22	660
N.	20	7	2	40	74	21	31	27	32	8	16	9	287
N. E.	5	1	2	0	0	7	4	3	12	3	9	7	53
E.	3	30	4	3	6	0	4	11	16	12	12	12	113
S. E.	97	124	74	76	36	0	14	64	43	111	75	108	822
Calm	437	340	482	315	303	455	532	483	410	360	481	465	5063
Check sum . .	744	672	744	720	744	720	744	744	720	744	720	744	8760

The preceding tabular results have been laid down graphically on the accompanying diagrams. The two rectangular diagrams show the quantity of each wind for each month; the first for the directions S., S. W., W., and N. W., the second for the directions N., N. E., E., and S. E. The circular diagram exhibits the quantity of each wind for the whole year, as indicated by a full line according to the scale at the foot of the diagram. It likewise shows, by a dotted line, the relative frequency of each wind during the year (on a ten times larger scale).


Miles.
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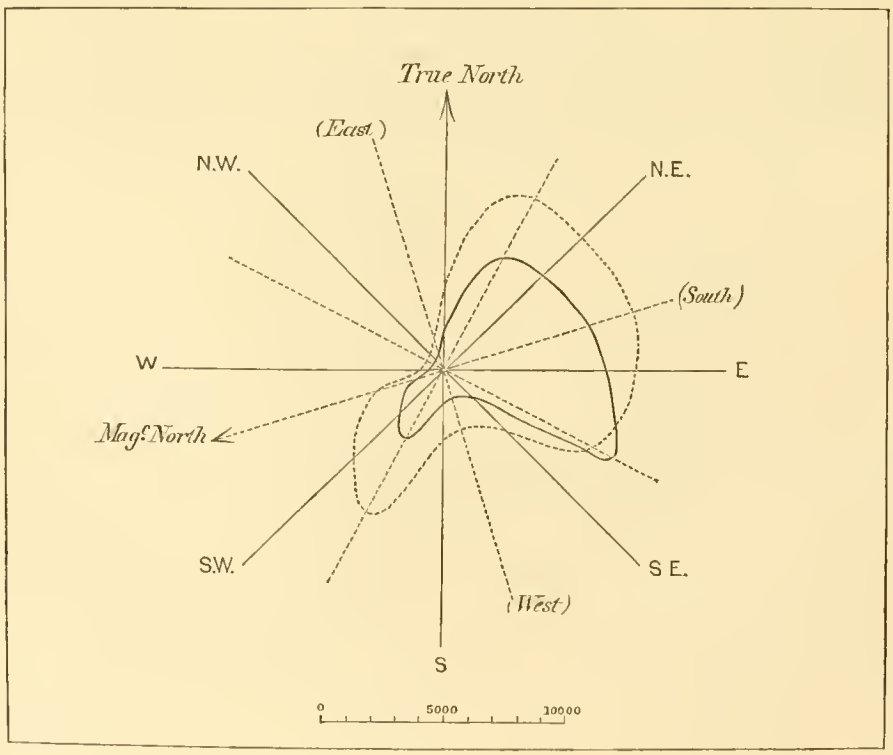
North
North East


True North
(East)
N.W.
N.E.
(South)
W
E
Mag! North
S.W.
S E.
(West)
S
0
5000
10000

The greatest quantity of air moved over the place during the year comes from a quarter bounded by the true directions S. E. by E. and N. N. E.; the prevailing wind also comes from this quarter. With the exception of true S. W. by S. winds, there is comparatively hardly any wind from the remaining directions; the quadrant between (true) west and north is particularly defective in this respect.

The calms greatly predominate, there being during the year more hours of calm (5063) than hours of wind from any direction (3697)—a circumstance quite characteristic of the locality.

Average Duration of the Winds.—The number of consecutive hours during which any one wind blew is given in the table below. It contains average values made out from all observations during the seventeen months. The number of consecutive hours during which, on the average, calms lasted, is likewise given.

Magnetic direction.	Mean duration.	Magnetic direction.	Mean duration.
S.	$2^{h}.8$	N. E.	$2^{h}.1$
S. W.	3.4	E.	2.1
W.	2.0	S. E.	3.3
N. W.	3.4		
N.	2.7	Calm	7.8

Rotation of Winds.—Owing to the great number of calms, and partly, also, to the generally small quantity and velocity of the winds between the (true) S. and (true) N. W. directions, Dove's laws of rotation cannot well be verified in this locality. There is, however, a tendency of the magnetic S., S. E., and E. (E. N. E., N. N. E., and N. N. W., true) winds to shift, in accordance with the law, in the proportion of three cases for to one case against it, or with a relative probability of three-fourths in favor of the law.

Note on the Occurrence of Gales.—Between September 1st, 1853, and January 24th, 1855, there were recorded thirteen gales (with a force of 7 and above, and a duration of not less than two hours). The date, direction, and duration of these gales is shown in the following table.

Date.		General (mag.) direction.	Duration.	Date.		General (mag.) direction.	Duration.
1853	Dec. 10	S. E.	2^{h}.	1854	Sept. 30	S. W.	16^{h}.
	Dec. 28	S. E.	22		Oct. 15	S. E.	3
1854	Feb. 7	S. E.	3		Nov. 20	S. W.	10
	Feb. 15–16	S.	4		Dec. 18	S. E.	5
	April 15–16	S. W.	7	1855	Jan. 13	S. E.	3
	June 17	S. W.	3		Jan. 18–19	S. W.	4
	July 28	S. W.	6				

These gales do not appear to be confined to any particular season of the year. On the average they last seven hours, and in summer they have a tendency to blow from the S. W. (true E. S. E.), and in winter from the S. E. (true N. N. E.). These two directions are the only ones from which gales were observed.

Thermometric and Barometric Wind Rose.—The investigation of the connection of the temperature and weight of the atmosphere with the direction of the wind, will be found in the discussion of the observations for temperature and barometric pressure, parts I and III of this paper.

Relation of the Direction of the Wind to the Amount of Snow (or Rain).—The dependence of the fall of snow (or rain) on the direction of the wind, is shown in the following table, which contains the aggregate number of hours during which snow (or rain) fell for any direction of the wind and during calms.

Direction (mag.)	Hours.	Direction (mag.)	Hours.
S.	52	N. E.	6
S. W.	71	E.	10
W.	43	S. E.	75
N. W.	110	Calm	328
N.	45	Total	740
			in 17 months.

The snowy (or rainy) quarter is between N. N. E. (true) and E. S. E. (true), or from the direction of the Spitzbergen Sea, and also from the direction S. S. W. (true), or from the upper Baffin Bay. During almost half the time, it snowed during calms. From the directions W. N. W. (true) and N. N. W. (true), there was hardly any precipitation.

PART III.

ATMOSPHERIC PRESSURE.

RECORD AND DISCUSSION OF THE ATMOSPHERIC PRESSURE.

The barometric observations at Van Rensselaer Harbor, North Greenland, were made hourly, and commence June 8th, 1853. The record now available, however, commences with June 27th, 1853, and extends to January 24th, 1855. The mean daily values subsequent to this date, up to April 22d, 1855, inclusive, together with the corresponding mean temperature, are to be found in Appendix No. XII. second volume of the Narrative of the Expedition. It is proposed to discuss here the observations taken between September 1st, 1853, when the brig entered her winter quarters in Van Rensselaer Bay, and January 24th, 1855, at which date the log-book on hand terminates.

Instruments.—The expedition was provided with a mercurial barometer and two aneroids. The mercurial marine barometer was made for Dr. Kane by Mr. Tagliabue, of New York. Its length was thirty-three and a half inches; it had a brass scale seven inches in length, and a glass cistern with an adjusting point for the surface of the mercury. In its adjustment, the correction for capillarity was included.[1] The readings are expressed in English inches. The aneroids have the numbers 4796 and 1400. Of these, the first one was read daily (and hourly) from the commencement of the record (June 27th, 1853) till its conclusion (January 24th, 1855). That aneroid 4796 (and not 1400) was thus used, I infer from a note in Mr. Sonntag's report dated Godhavn, September 12th, 1855, and in which he refers to the comparisons between this aneroid and the mercurial barometer, for the purpose of deducing the corrections to the former. These comparisons, as found recorded in the volume containing meteorological constants, commence with September 30th, 1853, and end on January 9th, 1854—65 in number.

The readings of the mercurial barometer commence October 24th, 1853, and terminate with January 24th, 1855. The preference has been given to these readings. The indications of the aneroid were only used for the time between September 1st and October 24th, 1853; its readings are also valuable as corroborating those of the mercurial barometer.

The aneroid was kept on deck till September 19th, 1853, 9 A. M., when the temperature was so low that the attached thermometer failed to record. The instrument was then taken into the cabin; its position there was six feet lower than on deck.

In his reduction of a part of the above 65 comparisons between the mercurial

[1] The above information of the construction of the instrument was received from the maker. Scale and cistern were connected by brass.

and aneroid barometers, the reduction of the former to the temperature 32° is applied by Mr. Sonntag, astronomer to the expedition, for the case of a brass connection between the cistern and scale. Table No. XVII. Series C, p. 63, in Guyot's Meteorological and Physical Tables, edition of 1858, prepared for the Smithsonian Institution, answers this case, and has been adopted by me for the temperature reductions. This reduction, in general, is not very great, as may be seen on p. 425, Appendix No. XII. of the second volume of the Narrative, where the mean readings of the attached thermometer, for the year 1854, is given as +40°.3.

Reduction of the Aneroid to the Mercurial Barometer.—A number of comparisons of the two instruments, for the purpose of reducing the readings of the first to their equivalent values by the second instrument, were made, as stated above. The differences in the indications of the mercurial and aneroid barometers, or $M - A$, may be supposed to be proportional to the variations in pressure and temperature, and may be represented by the equation

$$B = A + c + m\,(A - \text{mean pressure}) + n\,(T - \text{mean temperature}),$$

c being an index error. The quantities c, m, n, are to be determined from the following comparisons. In the absence of any better information, the attached thermometers were supposed free of index error. The comparisons were made by Mr. Sonntag.

TABLE OF COMPARISONS OF ANEROID BAROMETER No. 4796 WITH TAGLIABUE'S MERCURIAL BAROMETER.

No.	Date.	Hour.	Mercurial barometer.	Att'd ther.	Aneroid barometer.	Att'd ther.	Mer'l bar. referred to same temp.	No.	Date.	Hour.	Mercurial barometer.	Att'd ther.	Aneroid barometer.	Att'd ther.	Mer'l bar. referred to same temp.
	1853		Inch.	°	Inch.	°	Inch.		1853		Inch.	°	Inch.	°	Inch.
1	Sept. 30	21	29.962	21.3	30.00	65	30.080	35	Nov. 30	21	29.730	39.0	29.67	77	29.832
2	Oct. 1	2	29.925	23.8	29.93	72	30.055	36	Dec. 3	21.5	29.833	35.0	29.76	80	29.952
3	" 1	12	29.790	11.0	29.84	62	29.927	37	" 4	21.5	29.640	37.0	29.58	75	29.740
4	" 1	23	29.653	21.7	29.66	70	29.780	38	" 5	21.5	29.448	36.5	29.39	80	29.562
5	" 2	12	29.440	15.9	29.46	70	29.582	39	" 6	21.5	29.660	32.0	29.625	76	29.776
6	" 2	22	29.165	22.0	29.19	76	29.305	40	" 7	21.5	29.725	31.4	29.68	76	29.843
7	" 3	3	29.122	34.2	29.18	64	29.199	41	" 8	21.5	29.686	27.0	29.66	74	29.811
8	" 3	12	29.140	26.8	29.22	65	29.240	42	" 9	21.5	29.850	36.2	29.78	75	29.953
9	" 3	23	29.308	29.0	29.35	64	29.400	43	" 10	21.5	29.870	41.5	29.80	74	29.956
10	" 24	20.5	29.765	49.2	29.70	77	29.839	44	" 11	21.5	29.952	37.0	29.90	77	30.059
11	" 25	20.5	30.165	48.9	30.05	78	30.244	45	" 13	21.5	30.022	37.0	29.93	81	30.140
12	" 26	21	29.960	41.4	29.87	76	30.051	46	" 14	21.5	29.898	33.2	29.81	83	30.030
13	" 27	21	29.800	33.0	29.74	75	29.911	47	" 15	21.5	29.860	34.7	29.79	82	29.985
14	Nov. 4	21	29.732	36.0	29.67	75	29.835	48	" 16	21.5	29.802	37.2	29.73	79	29.912
15	" 5	21	29.610	34.6	29.53	78	29.723	49	" 18	21.5	30.000	40.2	29.89	80	30.106
16	" 6	21	29.825	42.3	29.73	78	29.922	50	" 20	21.5	30.105	39.2	30.00	79	30.211
17	" 7	21	29.966	37.2	29.87	78	30.075	51	" 21	21.5	29.475	40.0	29.43	75	29.567
18	" 8	21	29.916	34.2	29.84	76	30.026	52	" 22	21.5	29.760	42.0	29.70	79	29.858
19	" 9	21	29.230	32.9	29.20	77	29.345	53	" 23	21.5	30.188	40.5	30.07	82	30.301
20	" 10	21	29.330	38.5	29.26	79	29.436	54	" 24	21.5	30.230	35.2	30.135	80	30.350
21	" 11	21	29.555	41.6	29.475	76	29.645	55	" 25	21.5	30.270	40.0	30.175	77	30.369
22	" 12	21	30.130	39.2	30.05	76	30.228	56	" 26	21.5	29.425	46.0	29.35	78	29.508
23	" 13	21	30.213	34.8	30.14	72	30.309	57	" 31	21.5	29.610	41.0	29.56	78	29.707
24	" 15	21	29.895	29.0	29.82	74	30.016		1854						
25	" 17	21	29.750	30.2	29.70	76	29.872	58	Jan. 1	21.5	29.600	43.0	29.55	79	29.695
26	" 18	21	29.735	32.8	29.675	77	29.853	59	" 3	21.5	29.300	37.0	29.27	76	29.400
27	" 20	21	29.720	29.2	29.67	74	29.838	60	" 4	22.5	29.510	36.5	29.47	77	29.617
28	" 21	22	29.777	24.8	29.73	76	29.912	61	" 5	21.5	29.515	45.0	29.46	75	29.593
29	" 22	21	29.922	34.5	29.84	80	30.044	62	" 6	21.5	29.790	42.6	29.70	78	29.882
30	" 24	22	29.616	33.7	29.57	77	29.730	63	" 7	21.5	29.760	47.3	29.68	74	29.831
31	" 25	21	29.605	35.2	29.55	75	29.709	64	" 8	21.5	29.925	37.0	29.90	70	30.013
32	" 27	21	29.210	41.0	29.175	84	29.321	65	" 9	21.5	29.700	43.0	29.65	74	29.781
33	" 28	21	29.375	42.4	29.32	79	29.470								
34	" 29	22	29.665	41.3	29.59	75	29.753		Means	...	...	...	29.672	75.78	29.831

The constant c is, therefore, + 0.159 inches, at a mean temperature 75°.78 and a mean barometric pressure 29.831. To deduce the coefficients m and n, the correction c has first been applied to the aneroid readings. The following differences were then formed: $B-(A+c)$, $(A+c)-29.831$, and $T-75°.8$. We then have the 65 conditional equations:—

$$\begin{aligned}
1.\quad & -0.079 = +0.328\,m - 10.8\,n \\
2.\quad & -0.034 = +0.258\,m - 3.8\,n \\
3.\quad & -0.072 = +0.168\,m - 13.8\,n \\
4.\quad & -0.039 = -0.012\,m - 5.8\,n \\
& \text{etc. etc.}
\end{aligned}$$

Their solution furnishes m and n. Making first the coefficient of n as great as possible, by addition and change of sign of the equation when necessary, we find

$$\begin{aligned}
& 203.4\,n + 0.846\,m = +1.374 \\
\text{or,}\quad & n = +0.00675 - 0.004\,m,
\end{aligned}$$

and, in like manner, m results from the equation—

$$\begin{aligned}
& 12.56\,m + 40\,n = +1.190 \\
& m = +0.072, \qquad \text{and } n = +0.0065
\end{aligned}$$

Hence the formula for reduction—

$$B = A + \overset{\text{Inch.}}{0.159} + 0.072\,(A - \overset{\text{Inch.}}{29.672}) + 0.0065\,(T - 75°.8).$$

To show the result by the formula in extreme cases, the following eight comparisons are here inserted.

			Inch.		Inch.	Difference.
No. 3	Lowest temp.	Computed reading B =	29.92,	same observed (M) =	29.93	—0.01
" 9		"	29.41,	"	29.40	+0.01
" 32	Highest temp.	"	29.35,	"	29.32	+0.03
" 46		"	30.03,	"	30.03	0.00
" 23	Greatest pressure	"	30.31,	"	30.31	0.00
" 54		"	30.35,	"	30.35	0.00
" 6	Least pressure	"	29.33,	"	29.31	+0.02
" 7		"	29.23,	"	29.20	+0.03

These differences prove a sufficient approximation in the terms of the above expression, and likewise leave no doubt that the indications of the aneroid may generally be relied on to nearly within one-hundredth of an inch.

To facilitate the reduction, the following table of corrections has been calculated according to the above formula:—

	Temperature.									
Barometer.	15°	20°	25°	30°	40°	45°	50°	52°.5	55°.0	57°.5
29.0	—0.28	—0.25	—0.22	—0.19	—0.12	—0.09	—0.06	—0.04	—0.02	—0.01
29.5	—0.25	—0.22	—0.18	—0.15	—0.09	—0.05	—0.02	0.00	+0.01	+0 03
30.0	—0.21	—0.18	—0.15	—0.12	—0.05	—0.02	+0.01	+0.03	+0.05	+0.07

Barometer.	60°.0	62°.5	65°.0	67°.5	70°.0	72°.5	75°.0	77°.5	80°.0	
29.0	+0.01	+0.03	+0.04	+0.05	+0.07	+0.09	+0.11	+0.13	+0.14	...
29.5	+0.04	+0.06	+0.08	+0.09	+0.11	+0.13	+0.14	+0.16	+0.17	...
30.0	+0.08	+0.09	+0.11	+0.13	+0.15	+0.16	+0.18	+0.19	+0.21	...

The hourly record of the barometer and attached thermometer readings is given for mean local time, English inches and degrees of Fahrenheit, and for an average elevation of the cistern of the barometer above the mean level of the sea of five feet.

For the months of September and October, 1853, the barometric and thermometric means are not directly comparable with the corresponding figures in Appendix No. XI. of the Narrative (2d vol.) for this reason: In the Appendix the uncorrected aneroid readings are given, while the present abstract contains the corrected or referred readings according to the preceding investigation. After October 23d, the readings of the mercurial barometer take the place of the aneroid readings.

A star (*) attached to any date in the following record indicates that a corresponding remark will be found in the notes appended to the abstract.

Occasional omissions in the hourly record of either barometer or thermometer readings, as seen by the blanks in the table, have in all cases been supplied by simple interpolations before the means (hourly or daily) were taken, in order to give the result independent of these omissions.

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,
In September, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.
Aneroid Barometer in cabin. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.80	68	.79	64	.80	68	.81	69	.78	63	.76	63	.76	74	.74	74	.73	73	.71	70	.72	72	.70	71	.69	66
2d	.67	67	.69	69	.69	69	.68	68	.70	75	.70	73	.69	72	.67	68	.68	70	.66	68	.66	68	.67	67	.69	66
3d	.71	68	.72	68	.72	68	.74	70	.71	66	.71	64	.72	64	.72	64	.74	65	.74	64	.75	66	.77	72	.76	70
4th	.83	68	.81	66	.83	68	.80	64	.81	66	.80	64	.84	68	.86	73	.84	72	.83	70	.82	67	.81	60	.87	71
5th	.89	66	.90	66	.88	63	.93	70	.87	72	.84	65	.86	65	.85	64	.85	64	.85	68	.83	70	.83	70	.78	65
6th	.81	65	.86	66	.88	68	.86	66	.83	62	.86	64	.86	64	.86	62	.86	66	.85	65	.85	63	.85	63	.85	66
7th	.55	68	.53	69	.57	71	.46	71	.38	67	.39	70	.34	69	.31	66	.28	65	.30	68	.35	72	.34	72	.26	75
8th	.25	70	.23	71	.24	68	.22	65	.23	63	.25	71	.24	69	.25	68	.27	67	.27	68	.27	68	.27	68	.25	64
9th	.32	66	.22	60	.30	52	.32	52	.33	54	.33	54	.33	52	.35	59	.36	62	.38	64	.37	64	.36	64	.37	66
10th	.38	60	.38	60	.41	62	.40	61	.43	65	.43	65	.43	62	.46	64	.47	68	.46	67	.45	66	.45	66	.50	66
*11th	.49	62	.49	63	.49	63	.49	63	.47	54	.48	62	.50	64	.50	65	.52	67	.53	68	.53	66	.50	65	.50	65
12th	.57	63	.59	62	.59	63	.64	63	.67	60	.67	63	.65	61	.68	64	.68	63	.70	66	.70	65	.71	68	.71	68
13th	.49	65	.53	67	.49	66	.52	63	.52	66	.54	67	.53	63	.57	62	.57	62	.56	61	.57	62	.57	62	.54	64
*14th	.52	60	.53	62	.51	60	.55	68	.55	69	.54	67	.55	68	.52	67	.49	63	.54	67	.53	66	.53	69	.51	66
15th	.35	20	.41	21	.42	22	.40	22	.36	17	.37	18	.38	18	.38	18	.43	24	.41	23	.42	24	.41	24	.41	26
16th	.40	13	.43	13	.43	13	.44	13	.42	13	.45	14	.47	15	.49	16	.51	18	.52	18	.52	19	.50	19	.50	19
17th	.67	26	.67	26	.67	26	.70	29	.71	23	.63	18	.66	24	.65	21	.70	29	...	...	...	...	...	...	.73	29
18th	.72	13	.73	14	.73	13	.74	14	.72	11	.72	12	.74	14	.75	18	.79	22	.81	26	.81	27	.83	34	.81	29
*19th	.73	22	.73	22	.74	23	.73	22	.65	10	.65	11	.64	(9)	.64	(9)	.66	12	.86	60	.88	62	.89	65	.89	65
20th	.94	69	...	...	.94	69	.90	58	.91	61	.91	61	.92	62	.93	60	.91	60	.91	59	.89	60	.88	60	.80	42
21st	.83	61	.83	59	.85	56	.83	54	.84	55	.84	54	.84	54	.87	62	.87	62	.89	64	.86	60	.85	56	.83	54
22d	.86	55	.85	54	.87	58	.87	57	.87	56	.90	56	.90	56	.90	56	.90	54	.88	51	.86	48	.87	50	.88	50
23d	.88	48	.89	48	.90	50	.91	52	.93	55	.90	50	.87	44	.86	42	.86	43	.87	45	.88	46	.88	46	.87	43
24th	.92	61	.90	56	.89	54	.88	52	.89	58	.88	58	.88	58	.87	58	.89	62	.87	60	.87	58	.87	61	.85	60
25th	0.91	(59)	0.93	58	0.96	57	0.99	56	1.01	54	1.05	52	1.05	52	1.05	52	1.07	54	1.10	58	1.10	58	1.11	64	1.12	64
26th	1.13	63	1.11	61	1.09	57	1.12	58	1.13	54	1.13	53	1.13	55	1.15	60	1.10	56	1.12	57	1.08	56	1.08	60	1.06	57
27th	0.99	62	0.99	62	1.02	64	0.98	60	0.97	58	0.91	55	0.91	58	0.89	58	0.99	57	1.00	58	0.99	58	0.99	58	0.96	56
28th	1.02	58	1.02	58	1.01	57	1.02	60	1.04	58	1.03	58	1.04	60	1.02	58	...	...	1.07	70	1.05	67	1.07	68	1.01	60
29th	1.01	66	1.01	66	1.04	70	1.06	74	1.03	70	1.05	70	1.04	68	1.01	65	0.99	64	0.99	64	0.99	62	0.98	60	0.98	(59)
30th	1.07	65	1.02	60	1.02	60	1.03	61	1.05	62	1.07	60	1.04	54	...	...	1.06	56	1.06	56	1.04	54	1.03	53	1.05	55
Means	.724	55.9	.724	54.8	.733	55.3	.734	56.5	.727	53.9	.726	53.7	.727	53.9	.728	54.4	.737	55.2	.748	58.7	.745	58.4	.744	59.1	.734	56.9
B. at 32°	29.651		29.654		29.663		29.660		29.660		29.659		29.660		29.660		29.667		29.669		29.667		29.663		29.659	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.70	68	.74	73	.65	68	.67	67	.66	66	.65	64	.66	66	.66	66	.64	65	.66	67	.67	68	.715	68.0	.610
2d	.63	60	.63	60	.67	65	.67	66	.67	65	.66	64	.66	64	.67	63	.69	69	.70	66	.68	64	.674	66.9	.571
3d	.75	69	.76	70	.79	73	.79	73	.79	71	.81	70	.82	70	.82	70	.82	70	.81	68	.82	68	.762	68.4	.656
4th	.87	74	.88	75	.86	70	.86	68	.88	67	.87	65	.88	66	.87	63	.87	66	.88	66	.90	68	.849	67.7	.745
5th	.78	63	.78	61	.79	60	.86	70	.83	67	.86	69	.85	68	.82	67	.79	63	.81	65	.80	64	.839	66.0	.739
6th	.79	65	.81	62	.79	61	.72	62	.83	76	...	...	.72	70	.67	72	.63	74	.59	70	.55	68	.791	66.4	.690
7th	.25	70	.24	68	.17	68	.23	68	.28	69	.24	66	.29	64	.27	67	.26	67	.25	68	.30	74	.327	68.8	.221
8th	.25	68	.25	64	.27	66	.28	64	.35	66	.27	67	.29	65	.30	66	.31	64	.29	62	.29	62	.266	66.4	.167
9th	.38	68	.39	70	.38	68	.41	68	.43	68	.42	67	.42	67	.43	66	.41	64	.41	64	.41	64	.368	63.5	.278
10th	.50	66	.51	70	.51	70	.50	64	.53	66	.53	66	.51	68	.49	66	.49	65	.49	64	.50	63	.457	65.0	.371
*11th	.49	67	.49	65	.49	68	.50	70	.50	70	.51	72	...	...	.53	68	.53	66	.53	63	.57	64	.505	65.3	.409
12th	.71	68	.71	68	.70	66	.67	64	.67	65	.65	66	.65	66	.63	65	.61	65	.58	67	.56	65	.654	64.8	.558
13th	.58	64	.59	68	.57	64	.57	62	.54	61	.54	61	.54	61	.57	65	.58	67	.55	66	.54	66	.549	64.0	.455
*14th	.51	64	.35	25	.36	26	.40	28	.38	26	.37	25	.37	26	.34	19	.31	16	.31	16	.33	18	.454	47.5	.404
15th	.42	27	.43	29	.41	26	.40	25	.38	22	.38	21	.37	20	.39	20	.40	18	.44	18	.38	17	.398	21.7	.416
16th	.54	26	.59	29	.59	29	.62	30	.62	27	.63	30	.63	30	.63	31	.60	25	.64	24	.66	23	.503	21.1	.523
17th	.73	29	.73	29	.73	29	.71	22	.71	22	.73	23	.71	21	.72	20	.71	19	.73	19	.70	17	.700	24.6	.710
18th	.81	32	.79	27	.79	27	.76	23	.74	21	.73	20	.74	21	.71	18	.68	14	.68	14	.68	14	.750	19.9	.773
*19th	.88	63	.91	69	.91	68	.91	66	.92	67	.87	63	.87	61	.86	58	.86	59	.86	59	.86	60	.808	45.4	.763
20th	.80	42	.84	42	.78	38	.78	38	.79	39	.82	51	.81	53	.90	60	.93	68	.84	61	.84	61	.871	56.2	.797
21st	.82	53	.89	65	.87	63	.88	63	.85	59	.85	59	.83	56	.84	56	.84	56	.84	54	.84	56	.849	58.0	.771
22d	.88	48	.88	48	.98	60	.92	50	.92	50	.91	50	.90	50	.90	53	.91	56	.91	56	.89	48	.892	52.9	.826
23d	.88	46	.89	47	.92	53	.92	53	.94	56	.97	61	.98	62	.97	62	.99	66	.99	68	.95	66	.913	52.2	.850
24th	.85	62	.84	60	.85	60	.89	60	.89	60	.89	60	.89	59	.90	60	.94	65	.94	65	.90	60	.885	59.5	.802
25th	1.14	66	1.14	66	1.12	64	1.10	60	1.11	58	1.12	58	1.12	59	1.13	60	1.15	64	1.15	66	1.14	64	1.077	59.3	.994
26th	1.05	53	1.06	54	1.10	58	1.10	58	1.07	58	1.06	56	...	62	1.03	60	1.04	64	1.00	64	1.01	66	1.082	58.3	1.002
27th	0.96	54	0.97	56	0.99	57	0.99	56	0.99	54	0.97	52	0.99	55	1.01	58	1.01	58	1.02	58	1.03	60	.980	57.6	.903
28th	1.02	60	1.01	60	1.02	60	1.00	56	1.01	58	0.99	58	1.00	58	0.98	58	0.99	60	0.98	60	0.97	60	1.017	60.9	.930
29th	0.97	(58)	0.97	(57)	0.97	(56)	0.97	55	0.96	56	0.98	55	1.01	58	1.03	58	1.03	60	1.09	68	1.09	68	1.010	62.8	.919
30th	1.05	55	1.05	55	1.03	53	...	...	1.11	54	1.12	56	1.11	56	1.09	54	1.13	58	1.13	58	1.13	58	1.067	56.8	.992
Means	.733	56.9	.732	56.4	.735	56.4	.738	55.5	.745	55.5	.739	55.0	.739	55.2	.738	55.6	.738	56.4	.737	56.1	.733	55.8	.735	55.9	
B. at 32°	29.658		29.658		29.661		29.666		29.674		29.669		29.668		29.667		29.665		29.664		29.660		29.662		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,

In October, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Aneroid in cabin, Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahr.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	1.12	58	1.13	60	1.14	62	1.17	66	1.08	56	1.09	56	1.10	60	1.13	66	1.11	65	1.10	64	1.10	70	1.11	74	...	...
2d	.93	62	.93	62	.93	62	.90	64	.88	(64)	.88	(64)	.87	(64)	.87	(64)	.81	65	.82	72	.78	70	.78	70	.78	70
3d	.56	80	.55	78	.52	73	.49	68	.34	60	.35	60	.32	60	.32	(60)	.32	60	.34	62	.40	64	.37	64	.36	65
4th	.29	68	.29	68	.31	70	.36	64	.36	(64)	.40	(64)	.45	(64)	.45	(64)	.41	64	.39	62	.39	62	.40	64	.45	69
5th	.51	64	.52	66	.53	67	.53	67	.53	68	.53	68	.53	68	.53	69	.53	69	.54	70	.53	69	.54	69	.53	64
6th	.52	62	.52	63	.52	62	.55	68	.54	64	.57	66	.54	66	.54	66	.58	75	.58	75	.61	78	.62	81	.62	78
7th	.75	76	.76	74	.79	74	.81	74	.75	65	.79	73	.83	70	.85	75	.81	68	.86	70	.88	70	.91	74	.93	70
8th	.89	74	.86	74	.82	75	.83	77	.79	(70)	.73	63	.74	64	.73	64	.84	75	.83	73	.82	69	.81	68	.86	60
9th	1.23	68	1.25	68	1.25	65	1.25	63	1.26	64	1.30	68	1.34	69	1.39	78	1.36	71	1.36	72	1.37	74	1.37	74	1.37	74
10th	1.35	78	1.29	74	1.26	72	1.23	70	1.24	70	1.28	74	1.30	76	1.32	78	1.25	70	1.27	73	1.29	74	1.29	74	1.30	72
11th	1.57	70	1.58	70	1.58	69	1.58	69	1.59	70	1.61	72	1.61	71	1.57	70	1.59	71	1.57	70	1.57	68	1.54	65	1.52	67
12th	1.39	70	1.38	73	1.38	78	1.39	80	1.38	76	1.37	76	1.38	74	1.37	70	1.35	68	1.33	64	1.36	63	1.37	64	...	...
13th	1.21	70	1.20	70	1.18	67	1.10	64	1.07	64	1.07	64	1.08	68	1.03	64	1.03	64	1.02	64	.99	60	.99	70	.99	70
14th	.85	65	.93	80	.93	80	.86	78	.87	76	.87	76	.85	71	.89	74	.86	72	.87	72	.86	70	.87	70	.86	70
15th	.81	70	.78	70	.75	64	.77	72	.79	74	.78	72	.77	72	.77	72	.75	72	.75	74	.74	72	.74	72	.75	76
16th	.90	70	.91	70	.93	74	.96	75	.97	76	.97	74	.96	72	.96	68	.96	68	.97	66	.97	63	.98	62	.98	64
17th	.97	67	.97	67	.98	68	1.00	68	1.01	70	.99	68	.97	64	.99	66	.97	65	.97	65	.96	64	.96	64	.98	66
18th	1.01	68	1.01	71	1.01	73	1.02	74	.98	70	.98	70	.98	70	.98	70	.95	66	...	...	...	...	...	...	...	...
19th	.94	72	.94	72	.93	71	.92	70	.92	70	.89	68	.89	68	.90	68	.90	68	.92	70	.92	70	.91	70	.90	71
20th	.87	69	.88	68	.89	70	.88	69	.88	68	.90	(69)	.89	(69)	.89	(70)	.90	71	.88	69	.89	73	.86	74	.87	74
21st	.85	76	.86	73	.89	72	.89	72	.90	(72)	.91	(72)	.91	(72)	.91	(72)	.91	73	.88	70	.97	66	.99	69	1.00	70
22d	1.07	73	1.06	72	1.08	68	1.11	82	1.09	76	1.09	74	1.16	72	1.17	72	1.18	72	1.16	68	1.18	68	1.17	69	1.20	72
23d	1.20	72	1.20	73	1.20	73	1.19	71	1.18	70	1.19	76	1.19	76	1.12	72	1.09	72	1.09	72	1.07	74	1.08	76	1.03	69
24th	.70	39	.70	44	.60	39	.60	35	.60	40	.61	41	.64	43	.64	45	.77	43	.76	44	.76	42	.76	41	.76	41
25th	.73	47	.73	44	.72	45	.70	46	.65	47	.65	47	.70	43	.75	44	.76	47	.74	43	.74	45	.74	45	.91	78
26th	1.10	47	1.10	50	1.10	49	1.10	45	1.10	45	1.12	45	1.12	47	1.12	47	1.20	45	1.15	45	1.16	45	1.16	45	1.17	49
27th	1.05	40	1.05	40	1.05	35	1.05	33	1.00	37	1.00	38	1.00	39	1.00	40	.96	41	.95	42	.94	41	.94	40	.95	48
28th	.80	33	.80	34	.80	31	.80	27	.80	28	.78	34	.75	36	.72	37	.80	37	.84	36	.84	35	.84	38	.83	47
29th	.84	35	.84	34	.84	25	.82	31	.78	36	.78	35	.76	37	.76	37	.76	34	.78	32	.78	33	.78	33	.76	36
30th	.67	32	.66	32	.60	34	.65	29	.68	35	.63	31	.63	33	.63	33	.60	34	.60	33	.60	33	.60	33	.60	32
31st	.64	35	.65	35	.64	34	.64	33	.65	35	.64	34	.65	32	.66	33	.63	32	.64	33	.65	34	.65	38	.70	30
Means	.914	62.2	.914	62.2	.908	61.3	.908	61.4	.892	60.6	.895	61.0	.900	61.0	.902	61.5	.901	61.1	.901	61.0	.906	60.8	.906	61.9	.916	63.1
B. at 32°	29.823		29.823		29.820		29.820		29.807		29.809		29.813		29.814		29.814		29.814		29.820		29.816		29.823	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	1.09	(72)	1.08	(72)	1.06	(72)	1.07	72	1.02	68	1.01	65	.98	60	.97	60	.93	60	.90	60	.90	60	1.062	64.6	.965
2d	.77	70	.74	(68)	.73	(66)	.70	64	.70	64	.70	61	.67	62	.62	60	.62	(65)	.57	(65)	.50	70	.770	65.3	.674
3d	.24	65	.23	66	.20	(65)	.21	64	.22	62	.23	64	.24	64	.24	64	.26	66	.26	66	.26	66	.326	65.3	.231
4th	.44	69	.42	68	.42	69	.44	66	.46	62	.46	61	.48	61	.51	66	.51	66	.51	65	.51	66	.421	65.2	.326
5th	.55	65	.55	64	.55	64	.57	64	.51	63	.53	63	.53	63	.53	64	.54	66	.54	66	.55	67	.535	66.1	.436
6th	.56	70	.62	70	.61	68	.61	68	.61	68	.62	68	.62	68	.62	(67)	.65	(66)	.66	64	.68	63	.590	68.5	.484
7th	.94	70	.94	70	.92	71	.94	73	.96	75	.94	73	.94	73	.90	66	.91	72	.88	70	.86	70	.869	71.5	.756
8th	.87	62	.89	66	.86	61	.94	65	1.02	69	1.09	73	1.18	75	1.12	64	1.12	63	1.14	62	1.15	61	.914	67.8	.809
9th	1.35	70	1.34	74	1.33	73	1.32	72	1.31	72	1.30	70	1.26	64	1.29	(66)	1.30	(69)	1.31	(72)	1.33	(75)	1.314	70.2	1.202
10th	1.31	70	1.36	71	1.39	68	1.39	(68)	1.40	(69)	1.42	(69)	1.43	(70)	1.43	70	1.40	68	1.38	64	1.39	66	1.332	71.2	1.217
11th	1.51	66	1.50	64	1.48	62	1.48	64	1.43	66	1.42	64	1.42	64	1.40	66	1.39	64	1.39	65	1.40	66	1.512	67.2	1.406
12th	1.34	64	1.33	64	1.34	66	1.33	66	1.32	68	1.32	70	1.30	69	1.23	64	1.26	72	1.25	72	1.22	70	1.335	69.4	1.224
13th	.98	70	.95	68	.95	70	.94	69	.92	67	.93	68	.93	68	.90	70	.85	73	.86	70	.86	68	1.001	67.5	.896
14th	.86	70	.84	70	.84	68	.83	68	.82	67	.79	65	.78	64	.78	64	.77	64	.74	66	.80	76	.842	70.7	.730
15th	.76	70	.77	70	.77	70	.79	72	.80	71	.80	70	.81	70	.81	70	.81	70	.87	70	...	(70)	.784	71.0	.671
16th	.99	66	.98	64	1.00	67	1.02	68	1.02	68	1.01	67	1.01	72	1.03	74	1.05	76	1.01	72	1.01	74	.981	69.6	.871
17th	.96	64	.96	64	.98	64	.98	64	.98	64	.98	63	.99	64	1.01	66	1.02	68	1.02	68	1.00	66	.983	65.7	.883
18th	.99	70	.93	70	.93	70	.93	70	.91	67	.89	64	.91	66	.89	64	.91	66	.89	71	.88	70	.952	68.9	.843
19th	.86	70	.87	71	.86	70	...	...	.89	76	.87	74	.89	72	.88	70	.88	70	.86	70	.85	70	.895	70.5	.784
20th	.87	70	.86	70	.86	76	.84	71	.86	74	.86	73	.86	74	.86	74	.84	70	.83	70	.83	70	.869	71.0	.756
21st	1.00	70	1.01	71	1.00	70	1.00	69	.93	70	.95	68	.98	69	1.04	70	1.06	70	1.06	70	1.06	70	.957	70.7	.845
22d	1.20	72	1.19	71	1.19	71	1.22	72	1.23	72	1.22	69	1.22	69	1.22	70	1.22	72	1.21	(72)	1.20	(72)	1.168	71.7	1.051
23d	.99	68	.99	69	1.01	69	1.02	72	1.01	69	1.00	68	1.02	72	.99	76	.97	74	.95	72	.94	72	1.072	72.0	.955
24th	.76	46	.75	46	.74	43	.72	45	.75	47	.75	45	.75	46	.74	47	.74	43	.75	45	.73	45	.712	43.1	.674
25th	.91	78	.91	76	.98	82	.91	43	.92	44	.97	51	1.00	52	1.02	54	1.03	51	1.05	58	1.06	54	.845	52.6	.780
26th	1.16	49	1.15	47	1.10	44	1.10	41	1.11	42	1.09	41	1.09	40	1.12	(40)	1.10	(40)	1.09	(40)	1.08	(40)	1.120	44.5	1.077
27th	.95	48	.94	44	.94	49	.95	48	.90	47	.93	40	.93	38	.81	33	.79	34	.76	35	.76	35	.942	40.2	.911
28th	.85	47	.84	47	.85	36	.82	36	.82	37	.82	40	.82	37	.81	37	.81	38	.81	36	.81	38	.811	36.7	.789
29th	.75	33	.75	36	.76	31	.76	35	.75	36	.76	35	.72	36	.72	36	.72	37	.71	38	.70	37	.766	34.5	.751
30th	.60	34	.61	34	.61	36	.62	34	.62	35	.61	35	.61	35	.61	38	.62	37	.62	37	.62	36	.621	34.0	.606
31st	.72	32	.72	29	.73	29	.73	37	.74	32	.74	32	.74	33	.74	33	.75	33	.76	32	.76	33	.690	33.0	.678
Means	.907	62.6	.904	62.3	.903	62.2	.905	61.0	.901	61.0	.904	61.1	.907	60.3	.898	60.0	.898	60.7	.892	60.7	.890	61.1	.903	61.3	
B. at 32°	29.816		29.813		29.813		29.819		29.815		29.817		29.822		29.814		29.814		29.806		29.803		29.815		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,
In November, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.
Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.75	25	.75	23	.75	24	.75	26	.73	30	.74	30	.74	31	.74	32	.78	33	.78	34	.79	35	.79	34	.78	25
2d	.85	29	.85	28	.85	29	.85	29	.85	28	.85	31	.85	36	.85	37	.85	35	.85	32	.85	32	.85	29	.85	35
3d	.81	34	.82	30	.81	29	.81	28	.70	25	.80	25	.78	26	.78	25	.75	33	.75	24	.73	19	.72	23	.73	31
4th	.70	35	.71	32	.75	30	.75	28	.73	30	.72	28	.70	25	.70	26	.72	30	.74	34	.73	33	.75	36	.74	32
5th	.78	37	.78	35	.76	31	.76	32	.75	33	.75	30	.74	32	.78	35	.75	37	.74	37	.74	38	.74	40	.74	40
6th	.70	35	.69	35	.68	35	.68	35	.67	34	.65	33	.63	34	.62	33	.62	34	.62	34	.62	36	.57	34	.58	32
7th	.72	37	.75	37	.77	39	.77	39	.79	38	.79	40	.80	40	.82	41	.85	40	.78	39	.79	33	.75	35	.84	37
8th	.87	35	.87	35	.88	33	.88	34	.88	39	.90	39	.93	39	.90	37	.95	37	.95	37	1.00	39	1.02	37	1.02	38
9th	1.08	39	1.06	32	1.05	33	1.04	31	1.05	33	1.05	33	1.02	35	1.01	35	.92	34	.88	35	.84	34	.82	35	.75	35
10th	.24	35	.23	34	.20	33	.20	30	.15	32	.16	32	.20	31	.20	32	.23	34	.25	33	.30	34	.35	35	.40	34
11th	.59	34	.60	33	.55	32	.55	34	.50	34	.48	35	.44	34	.38	35	.35	30	.35	35	.35	38	.29	32	.22	38
12th	.23	28	.25	25	.30	24	.35	25	.41	32	.45	34	.47	34	.48	(36)	.54	38	.54	41	.52	38	.55	39	.60	38
13th	1.03	33	1.03	29	1.07	30	1.07	30	1.09	34	1.09	32	1.10	35	1.12	37	1.15	38	1.14	38	1.14	40	1.15	37	1.20	35
14th	1.22	29	1.22	31	1.22	32	1.22	32	1.22	33	1.22	32	1.20	33	1.20	33	1.21	35	1.20	35	1.23	34	1.22	35	1.23	33
15th	1.17	31	1.17	29	1.17	27	1.17	22	1.12	23	1.12	24	1.13	24	1.10	24	1.10	38	1.12	37	1.11	37	1.10	31	1.10	30
16th	1.00	24	1.00	24	1.00	25	1.01	26	.96	26	.93	23	.90	23	.85	23	.87	30	.86	27	.85	28	.85	29	.85	31
17th	.75	24	.75	28	.78	29	.78	26	.80	33	.82	31	.84	32	.84	32	.84	31	.86	30	.85	31	.87	32	.88	35
18th	.85	34	.85	36	.85	27	.85	27	.80	27	.80	27	.81	26	.76	27	.79	30	.75	30	.75	32	.75	31	.75	34
19th	.75	33	.74	34	.74	33	.74	33	.72	32	.74	34	.74	31	.73	34	.70	32	.77	33	.77	33	.77	32	.75	39
20th	.68	34	.68	33	.68	39	.68	37	.68	32	.69	31	.68	30	.65	30	.65	31	.62	31	.62	31	.64	30	.64	39
21st	.73	30	.73	28	.72	29	.72	30	.71	29	.71	27	.72	27	.72	28	.71	30	.71	32	.71	36	.71	32	.75	39
22d	.75	33	.75	30	.75	29	.75	26	.75	21	.75	20	.75	18	.75	22	.75	27	.77	30	.78	29	.80	32	.83	24
23d	.90	33	.90	33	.90	35	.90	34	.90	31	.90	31	.90	29	.90	31	.90	34	.92	34	.93	31	.93	31	.93	30
24th	.95	30	.95	29	.95	29	.95	32	.95	29	.95	30	.95	30	.95	30	.95	33	.95	34	.95	32	.95	33	.99	35
25th	.97	35	.90	34	.85	35	.78	32	.77	31	.75	32	.72	35	.69	35	.65	30	.60	32	.57	34	.56	37	.54	37
26th	.58	33	.59	33	.61	35	.61	36	.60	36	.60	32	.60	33	.60	32	.60	35	.60	35	.60	39	.60	40	.60	40
27th	.46	35	.44	35	.43	34	.41	33	.39	32	.35	32	.33	34	.29	37	.26	37	.26	37	.26	36	.25	37	.20	35
28th	.20	38	.20	37	.20	35	.20	36	.21	38	.24	37	.24	36	.22	38	.22	42	.22	41	.21	41	.20	40	.20	40
29th	.18	39	.20	38	.23	38	.25	39	.25	41	.20	39	.25	39	.30	40	.36	43	.41	41	.41	41	.42	41	.45	43
30th	.55	37	.60	35	.61	35	.61	35	.62	37	.62	37	.64	38	.65	45	.65	46	.65	37	.65	38	.65	40	.65	40
Means	.735	32.9	.735	31.8	.737	31.6	.736	31.2	.725	31.8	.727	31.4	.727	32.0	.719	32.7	.722	34.6	.721	34.3	.722	34.3	.721	34.3	.726	35.1
B. at 32°	29.713		29.726		29.729		29.728		29.717		29.719		29.718		29.708		29.706		29.705		29.706		29.705		29.709	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.80	23	.80	24	.80	26	.82	34	.84	34	.84	35	.85	33	.85	33	.84	33	.84	34	.84	34	.791	30.2	.787
2d	.85	27	.85	35	.86	33	.85	33	.86	32	.84	33	.85	32	.85	34	.89	34	.83	32	.82	33	.850	32.0	.841
3d	.68	30	.69	32	.70	38	.72	41	.72	37	.72	35	.72	35	.72	34	.72	34	.74	34	.70	29	.742	30.4	.737
4th	.74	30	.75	31	.75	30	.75	34	.75	36	.79	36	.78	36	.78	32	.78	37	.78	38	.79	37	.745	32.3	.735
5th	.72	41	.74	40	.74	39	.75	37	.75	39	.75	42	.75	40	.75	38	.75	37	.73	37	.70	37	.747	36.8	.725
6th	.59	33	.61	42	.68	40	.64	35	.63	36	.63	33	.64	37	.68	36	.69	38	.70	38	.72	38	.648	35.4	.630
7th	.84	37	.85	40	.85	38	.68	40	.69	37	.70	43	.72	35	.87	35	.87	37	.86	33	.86	36	.792	37.7	.767
8th	1.01	37	1.02	38	1.05	38	1.05	40	1.06	43	1.07	43	1.07	45	1.07	35	1.07	35	1.07	35	1.07	33	.986	37.5	.961
9th	.70	35	.65	38	.59	38	.50	37	.44	35	.40	40	.32	39	.30	36	.30	36	.26	34	.22	30	.719	35.1	.702
10th	.43	33	.43	34	.50	37	.59	30	.51	36	.58	36	.56	40	.58	37	.60	38	.60	36	.60	38	.379	34.3	.364
11th	.19	37	.15	36	.12	35	.11	39	.08	35	.07	35	.07	36	.10	35	.19	29	.12	38	.17	29	.292	34.5	.278
12th	.65	37	.70	40	.81	43	.83	42	.84	40	.88	41	.90	34	.95	32	.95	37	.96	39	.99	37	.631	35.6	.613
13th	1.22	36	1.22	36	1.22	34	1.22	38	1.23	39	1.22	37	1.22	37	1.20	36	1.19	34	1.21	37	1.20	35	1.155	35.3	1.137
14th	1.23	34	1.23	34	1.28	36	1.23	34	1.23	33	1.22	36	1.21	35	1.20	30	1.16	30	1.15	33	1.16	32	1.213	33.1	1.201
15th	1.10	32	1.10	35	1.10	31	1.11	36	1.09	30	1.07	28	1.06	29	1.05	28	1.05	29	1.02	26	1.03	25	1.102	29.4	1.100
16th	.85	34	.84	36	.83	41	.82	37	.80	36	.78	34	.78	33	.75	28	.75	31	.75	31	.75	27	.860	29.4	.857
17th	.88	30	.89	32	.89	33	.90	33	.90	32	.90	30	.90	29	.88	27	.85	31	.87	31	.85	28	.849	30.4	.845
18th	.75	34	.75	31	.75	33	.75	34	.75	35	.74	35	.73	35	.75	34	.75	33	.80	34	.76	33	.777	31.6	.768
19th	.75	36	.75	37	.75	36	.75	35	.73	36	.74	37	.73	38	.70	37	.70	37	.70	37	.71	39	.736	34.9	.718
20th	.65	39	.65	36	.65	37	.69	36	.70	36	.70	38	.70	39	.70	37	.70	37	.70	32	.70	33	.672	34.5	.656
21st	.75	38	.75	39	.75	31	.75	33	.75	36	.75	33	.75	33	.75	34	.75	30	.75	30	.75	31	.733	31.9	.724
22d	.84	23	.85	29	.85	32	.85	35	.85	35	.85	35	.85	39	.88	38	.90	34	.92	35	.92	37	.812	29.7	.809
23d	.93	29	.93	30	.93	33	.93	36	.93	33	.93	33	.93	36	.95	33	.95	34	.95	39	.95	29	.922	32.6	.912
24th	1.00	36	1.00	37	1.00	37	1.00	34	1.00	38	.99	39	.99	32	.99	31	.99	32	.98	32	.97	34	.971	32.8	.960
25th	.53	37	.53	40	.53	33	.51	35	.52	31	.55	32	.55	40	.56	30	.56	34	.57	35	.59	36	.640	34.2	.625
26th	.62	40	.60	38	.59	38	.59	37	.56	34	.52	31	.50	35	.50	37	.47	35	.47	36	.47	36	.570	35.7	.550
27th	.20	36	.20	35	.20	34	.20	40	.20	39	.20	34	.20	40	.20	43	.20	39	.20	37	.20	37	.272	36.2	.261
28th	.18	40	.16	40	.16	41	.14	39	.11	40	.10	43	.10	43	.12	41	.12	42	.15	42	.17	41	.178	39.6	.158
29th	.46	43	.49	41	.51	44	.52	41	.52	41	.55	41	.57	43	.57	40	.58	36	.58	36	.58	36	.410	40.2	.380
30th	.65	38	.65	38	.65	42	.70	40	.72	40	.74	43	.73	41	.72	42	.72	42	.72	41	.72	40	.661	39.5	.631
Means	.726	34.5	.728	35.8	.736	36.0	.732	36.5	.725	36.1	.727	36.4	.724	36.6	.732	34.8	.735	34.8	.733	35.1	.732	34.0	.728	34.1	
B. at 32°	29.710		29.709		29.716		29.711		29.705		29.706		29.703		29.715		29.718		29.716		29.717		29.713		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,

In December, 1853, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.73	37	.73	37	.73	35	.73	36	.75	35	.75	35	.75	36	.74	37	.74	40	.71	39	.70	37	.66	37	.65	39
2d	.47	35	.47	34	.47	35	.47	33	.48	31	.48	33	.49	33	.49	34	.50	35	.50	33	.50	40	.52	43	.53	43
3d	.60	35	.60	37	.60	37	.60	37	.59	38	.60	39	.60	35	.60	34	.61	37	.63	35	.63	36	.64	37	.64	39
4th	.70	35	.71	37	.71	35	.72	32	.75	40	.75	43	.75	38	.75	38	.75	33	.75	35	.77	35	.80	37	.84	38
5th	.83	37	.80	34	.80	34	.80	34	.80	30	.80	35	.71	35	.78	33	.65	37	.64	37	.60	37	.59	38	.57	35
6th	.48	38	.48	38	.48	36	.46	34	.46	35	.45	35	.45	35	.45	39	.45	34	.45	36	.45	34	.42	35	.43	34
7th	.57	34	.57	35	.57	35	.60	35	.59	30	.59	27	.60	28	.62	25	.66	31	.68	31	.69	25	.69	26	.68	28
8th	.75	29	.75	33	.75	32	.75	32	.75	34	.72	27	.72	24	.71	29	.72	31	.72	32	.72	30	.72	32	.73	33
9th	.65	28	.65	25	.65	24	.65	23	.67	27	.67	22	.67	25	.65	25	.70	29	.69	25	.69	24	.70	27	.69	25
10th	.76	37	.80	36	.81	37	.82	36	.80	35	.80	36	.82	37	.82	37	.83	36	.83	37	.85	35	.85	36	.85	34
11th	.95	40	.95	38	.95	40	.95	35	.94	34	.90	32	.90	32	.85	36	.85	36	.87	40	.85	35	.84	37	.82	37
12th	.88	36	.88	34	.87	33	.87	31	.90	36	.94	32	.94	29	.95	32	.95	35	.97	39	1.00	35	1.00	32	1.00	34
13th	1.03	34	1.03	31	1.03	31	1.03	33	1.04	31	1.03	33	1.03	32	1.03	33	1.03	34	1.03	34	1.02	33	1.02	34	1.01	36
14th	1.03	37	1.03	37	1.03	37	1.03	37	1.02	32	1.02	38	1.02	36	1.02	45	1.02	36	1.02	35	1.02	35	1.02	36	1.02	36
15th	1.03	36	1.03	36	1.03	32	1.03	33	.97	28	.97	32	.95	32	.93	32	.91	34	.90	35	.87	34	.86	31	.86	29
16th	.86	31	.86	24	.86	22	.86	25	.85	23	.85	24	.85	27	.85	41	.85	34	.85	33	.85	32	.85	33	.86	33
17th	.80	38	.80	37	.80	38	.80	37	.80	35	.80	32	.81	32	.80	36	.80	39	.80	35	.80	36	.80	35	.81	37
18th	.86	33	.86	31	.87	31	.91	32	.93	33	.94	34	.97	36	1.00	36	1.00	35	1.00	35	1.02	35	1.04	36	1.03	36
19th	1.12	33	1.12	35	1.12	33	1.12	35	1.12	36	1.12	36	1.10	38	1.08	39	1.00	43	.97	39	.95	39	.94	40	.92	42
20th	.55	35	.50	35	.50	38	.50	38	.46	38	.46	39	.44	39	.42	43	.45	32	.43	32	.40	37	.47	33	.41	40
21st	.80	35	.83	34	.87	33	.90	34	.96	37	1.02	40	1.04	37	1.09	38	1.10	39	1.10	38	1.10	36	1.10	36	1.10	40
22d	.80	36	.75	35	.73	34	.70	34	.65	34	.57	34	.57	33	.50	36	.50	40	.49	38	.47	39	.43	44	.39	45
23d	.55	38	.60	42	.60	38	.60	40	.65	39	.67	40	.70	40	.74	44	.74	41	.76	41	.76	39	.76	37	.77	40
24th	.85	42	.90	42	.95	41	.97	43	.97	42	1.03	41	1.07	41	1.11	42	1.11	41	1.20	40	1.20	35	1.20	36	1.23	37
25th	1.40	39	1.40	39	1.40	39	1.40	41	1.37	41	1.32	42	1.28	36	1.25	36	1.25	36	1.24	36	1.23	39	1.23	31	1.17	41
26th	1.25	35	1.25	37	1.25	36	1.25	35	1.27	35	1.27	36	1.27	36	1.27	37	1.27	41	1.27	43	1.27	40	1.27	41	1.19	39
27th	.86	39	.84	36	.80	37	.75	38	.65	39	.60	37	.55	40	.50	40	.49	44	.40	46	.40	45	.40	40	.25	40
28th	.15	45	.20	42	.25	42	.28	39	.30	37	.32	31	.40	33	.45	37	.45	43	.45	37	.54	39	.56	39	.57	26
29th	1.30	45	1.33	43	1.35	44	1.35	45	1.37	44	1.39	44	1.40	43	1.44	43	1.45	40	1.45	40	1.45	41	1.45	40	1.48	41
30th	1.45	36	1.40	35	1.40	35	1.40	33	1.40	35	1.40	36	1.36	36	1.34	37	1.34	35	1.34	35	1.34	33	1.34	31	1.26	35
31st	1.15	39	1.15	40	1.15	40	1.15	41	1.10	41	1.10	40	1.08	40	1.07	43	1.07	39	1.05	40	1.00	42	.97	41	.90	41
Means	.845	36.4	.847	35.8	.851	35.3	.853	35.2	.850	35.0	.849	35.0	.848	34.6	.848	36.7	.846	36.8	.845	36.5	.843	35.9	.843	35.8	.828	36.5
B. at 32°	29.824		29.827		29.832		29.835		29.833		29.832		29.832		29.826		29.824		29.824		29.823		29.824		29.807	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.65	39	.60	41	.60	43	.60	40	.60	40	.58	43	.58	39	.58	37	.56	36	.50	34	.50	36	.655	37.8	.631
2d	.52	38	.52	38	.55	42	.60	40	.60	40	.60	42	.61	42	.60	45	.61	41	.59	39	.59	40	.532	37.9	.508
3d	.64	38	.64	37	.64	39	.70	40	.73	43	.73	48	.73	48	.70	37	.70	35	.70	35	.71	35	.648	38.0	.623
4th	.84	38	.85	40	.85	41	.90	37	.90	37	.90	41	.90	36	.89	35	.88	35	.85	36	.85	36	.807	37.0	.785
5th	.55	37	.55	40	.55	40	.55	35	.53	35	.53	36	.53	37	.52	38	.52	38	.53	37	.54	38	.636	36.1	.616
6th	.43	34	.43	34	.43	37	.42	34	.45	34	.46	35	.46	31	.48	31	.49	38	.52	29	.52	30	.458	34.6	.442
7th	.70	30	.70	35	.72	34	.75	33	.75	33	.75	33	.75	33	.78	34	.75	33	.75	32	.75	30	.677	31.2	.670
8th	.74	34	.74	33	.75	34	.70	32	.70	32	.68	31	.68	31	.67	31	.66	31	.66	36	.66	31	.715	31.4	.707
9th	.70	25	.70	26	.70	28	.75	33	.75	34	.75	38	.75	36	.75	34	.75	32	.75	34	.75	36	.700	28.6	.700
10th	.85	36	.87	40	.87	41	.92	40	.92	39	.92	39	.92	41	.94	40	.94	40	.94	42	.94	41	.861	37.8	.837
11th	.82	36	.82	37	.82	36	.83	38	.82	34	.82	36	.82	37	.83	37	.84	35	.85	36	.85	35	.864	36.2	.844
12th	1.00	35	1.00	34	1.00	36	1.03	36	1.04	35	1.04	35	1.04	32	1.04	33	1.04	25	1.04	26	1.04	34	.978	33.3	.965
13th	1.01	36	1.01	38	1.00	40	1.00	36	1.00	32	1.00	37	1.00	37	1.00	35	1.00	36	1.01	35	1.01	37	1.017	34.5	1.001
14th	1.02	36	1.03	33	1.03	35	1.03	37	1.02	34	1.02	38	1.00	30	.99	27	.98	28	.97	30	.97	32	1.015	33.9	1.000
15th	.86	26	.86	37	.85	32	.85	36	.85	34	.85	29	.85	30	.86	37	.86	36	.85	34	.85	35	.905	32.9	.893
16th	.87	35	.87	30	.86	39	.84	39	.84	31	.84	34	.82	32	.80	33	.80	33	.80	36	.80	37	.843	31.7	.834
17th	.81	38	.82	31	.82	27	.83	29	.83	30	.83	31	.83	32	.83	30	.83	23	.84	30	.84	32	.814	33.3	.802
18th	1.03	35	1.03	38	1.05	38	1.10	31	1.10	39	1.10	39	1.10	41	1.12	37	1.12	36	1.12	34	1.12	33	1.017	35.2	.999
19th	.90	46	.90	45	.88	42	.85	38	.82	39	.80	44	.74	35	.62	41	.62	39	.62	42	.62	49	.919	39.5	.889
20th	.41	39	.45	38	.46	40	.55	43	.57	45	.60	42	.65	37	.75	35	.80	32	.80	34	.82	34	.535	37.4	.512
21st	1.05	39	1.10	39	1.10	41	1.06	37	1.04	36	1.02	43	1.00	40	.95	40	.90	35	.80	34	.75	33	.991	37.2	.968
22d	.36	42	.36	44	.36	44	.35	41	.36	37	.40	42	.41	35	.42	43	.45	36	.47	38	.50	40	.500	38.5	.473
23d	.80	38	.80	39	.80	44	.82	41	.82	40	.82	42	.82	42	.85	41	.86	40	.86	41	.87	44	.751	40.4	.720
24th	1.25	34	1.27	27	1.31	39	1.34	35	1.35	35	1.35	36	1.35	34	1.33	39	1.33	35	1.35	35	1.35	37	1.182	37.8	1.156
25th	1.17	37	1.19	36	1.17	42	1.19	39	1.19	37	1.18	35	1.18	34	1.20	35	1.20	40	1.23	34	1.25	35	1.254	37.5	1.229
26th	1.14	38	1.13	40	1.12	43	1.06	40	1.05	42	1.02	43	1.00	41	.95	40	.95	39	.90	37	.87	34	1.148	38.7	1.120
27th	.21	42	.20	43	.17	44	.14	43	.09	40	.08	40	.06	47	.05	45	.10	49	.15	47	.15	46	.370	42.0	.334
28th	.67	40	.74	27	.81	32	.90	31	.94	35	1.00	40	1.05	30	1.12	37	1.15	36	1.20	40	1.27	40	.657	36.6	.636
29th	1.48	36	1.49	38	1.51	35	1.50	31	1.50	30	1.50	35	1.49	37	1.50	36	1.50	38	1.48	38	1.45	36	1.442	39.3	1.413
30th	1.25	35	1.25	36	1.25	39	1.22	38	1.21	40	1.20	42	1.17	40	1.17	38	1.17	39	1.15	41	1.15	39	1.290	36.6	1.268
31st	.85	39	.84	39	.82	40	.77	39	.73	41	.75	36	.75	36	.72	(37)	.72	(39)	.67	(39)	.65	(41)	.925	39.7	.894
Means	.825	36.5	.831	36.5	.834	38.3	.844	36.8	.842	36.5	.843	38.2	.840	36.5	.839	36.7	.841	35.7	.837	36.0	.838	36.6	.842	36.2	
B. at 32°	29.804		29.810		29.808		29.822		29.821		29.817		29.819		29.818		29.822		29.817		29.817		29.821		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,

In January, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.65	42	.65	43	.65	43	.65	42	.64	42	.64	40	.64	40	.64	40	.63	39	.61	41	.61	42	.61	43	.60	40
2d	.56	40	.55	42	.55	43	.55	42	.55	41	.55	41	.55	44	.55	43	.61	43	.60	42	.60	41	.60	40	.64	37
3d	.70	38	.70	40	.68	39	.65	40	.62	43	.60	43	.56	45	.56	52	.56	48	.52	42	.50	39	.48	35	.43	37
4th	.35	36	.35	38	.35	39	.35	39	.35	40	.35	40	.34	40	.30	42	.30	39	.30	38	.30	35	.30	35	.30	39
5th	.40	36	.40	36	.42	37	.42	37	.44	37	.44	37	.46	37	.47	37	.48	37	.51	36	.52	34	.52	35	.50	36
6th	.45	42	.45	43	.45	43	.45	44	.41	40	.45	41	.47	39	.48	46	.49	42	.51	43	.52	46	.55	46	.57	36
7th	.74	43	.74	43	.74	43	.74	43	.74	43	.74	43	.74	44	.76	44	.76	42	.79	41	.79	37	.80	33	.73	39
8th	.80	40	.80	43	.80	43	.80	43	.80	45	.81	44	.81	48	.81	47	.77	46	.77	43	.75	42	.75	41	.75	42
9th	.90	40	.90	39	.90	40	.90	40	.90	39	.90	39	.92	39	.92	39	.94	36	.94	43	.93	42	.93	47	.95	50
10th	.75	39	.72	41	.72	40	.72	39	.72	36	.72	43	.72	50	.72	47	.70	41	.70	43	.70	37	.70	45	.70	65
11th	.63	39	.63	39	.62	37	.61	38	.60	35	.61	34	.55	40	.50	40	.56	37	.56	41	.55	41	.55	46	.55	35
12th	.45	50	.45	38	.47	37	.50	34	.50	32	.50	26	.50	25	.50	29	.50	37	.50	36	.50	36	.50	31	.51	37
13th	.69	39	.68	32	.68	36	.68	37	.70	35	.70	28	.70	30	.70	35	.70	39	.70	39	.70	40	.67	38	.69	35
14th	.53	26	.52	26	.52	28	.52	29	.55	28	.55	26	.53	24	.53	26	.53	28	.53	28	.53	29	.53	29	.51	29
15th	.40	23	.40	21	.40	21	.35	17	.35	22	.35	17	.34	10	.34	13	.28	13	.28	20	.26	14	.33	17	.37	15
16th	.50	13	.50	12	.50	9	.50	9	.50	17	.53	14	.53	14	.55	16	.55	12	.55	4	.55	12	.55	16	.55	13
17th	.60	10	.60	7	.60	19	.60	14	.60	20	.61	16	.60	11	.51	14	.57	9	.56	6	.56	11	.55	17	.55	15
18th	.56	19	.58	14	.56	15	.58	24	.56	14	.58	10	.58	11	.60	13	.60	21	.60	18	.60	21	.60	13	.62	13
19th	.57	12	.57	9	.57	10	.58	(9)	.57	9	.57	7	.57	8	.57	7	.57	15	.57	15	.57	19	.57	20	.57	18
20th	.70	8	.70	9	.70	8	.70	10	.69	17	.69	13	.69	9	.69	10	.69	18	.67	13	.65	12	.64	14	.64	10
21st	.45	12	.45	11	.45	12	.45	19	.34	13	.34	15	.34	21	.34	26	.34	27	.34	26	.34	27	.27	29	.26	22
22d	.25	27	.27	27	.27	29	.27	27	.27	21	.27	28	.27	21	.27	25	.27	28	.27	29	.27	30	.27	30	.28	29
*23d	.10	16	.10	15	.08	14	.05	19	.05	15	.05	14	.05	19	.05	25	*.97	26	*.92	24	*.87	22	*.86	22	*.86	24
*24th	*.95	30	*.95	25	*.95	28	*.95	30	*.95	31	*.97	29	*.97	29	*.97	27	*.97	28	*.97	29	*.95	23	*.95	27	.00	26
*25th	*.98	26	*.97	19	*.95	22	*.95	28	*.95	28	*.95	29	*.95	30	*.95	34	*.95	39	*.95	30	*.95	26	*.95	24	*.92	25
26th	.00	33	.00	32	.00	31	.00	31	.09	30	.06	30	.06	28	.08	27	.08	27	.08	20	.10	23	.10	27	.15	30
27th	.21	32	.21	31	.21	31	.21	34	.21	30	.21	29	.21	30	.20	31	.18	32	.18	26	.18	27	.18	30	.19	30
28th	.21	24	.21	22	.21	24	.21	26	.22	27	.22	25	.22	22	.22	28	.25	27	.25	26	.25	22	.25	19	.25	22
29th	.30	23	.30	19	.30	19	.30	17	.32	18	.32	20	.32	20	.32	23	.40	23	.35	17	.35	21	.37	22	.38	22
30th	.50	25	.49	23	.49	23	.49	22	.49	16	.50	14	.50	15	.50	16	.50	21	.50	20	.50	21	.50	19	.50	21
31st	.50	27	.50	22	.50	20	.50	19	.50	21	.50	24	.50	20	.50	21	.57	27	.57	26	.55	24	.57	25	.57	24
Means	.464	29.4	.463	27.8	.461	28.5	.459	29.1	.459	28.5	.460	27.7	.458	27.8	.455	29.8	.460	30.5	.456	29.2	.452	28.9	.452	29.5	.452	29.5
B. at 32°	29.461		29.465		29.461		29.457		29.459		29.462		29.460		29.452		29.454		29.454		29.451		29.450		29.450	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.60	39	.60	39	.60	42	.60	40	.60	41	.60	42	.60	39	.60	39	.60	40	.57	40	.55	39	.614	40.7	.582
2d	.70	39	.70	42	.72	40	.71	35	.74	39	.74	42	.74	42	.72	38	.70	39	.68	39	.69	39	.637	40.5	.605
3d	.43	34	.42	41	.42	37	.41	37	.41	42	.40	41	.40	39	.40	41	.41	38	.32	39	.35	39	.497	40.4	.465
4th	.30	40	.30	37	.30	37	.31	38	.32	38	.33	41	.34	39	.38	37	.39	36	.39	35	.39	36	.333	38.1	.307
5th	.50	39	.50	46	.50	49	.49	45	.49	45	.49	45	.46	44	.49	42	.49	42	.49	42	.44	42	.472	39.7	.443
6th	.57	46	.62	44	.62	47	.62	44	.63	43	.65	48	.66	46	.67	45	.68	45	.70	42	.75	43	.561	43.5	.521
7th	.73	39	.73	39	.73	39	.73	40	.75	40	.77	43	.80	45	.80	44	.80	41	.80	44	.80	43	.760	41.5	.726
8th	.75	46	.75	46	.75	40	.76	39	.77	41	.80	41	.82	40	.82	36	.82	37	.83	36	.85	37	.789	41.9	.753
9th	.95	50	.93	50	.90	46	.90	44	.90	41	.92	42	.90	40	.80	36	.77	36	.77	39	.77	40	.893	41.5	.858
10th	.72	68	.72	69	.73	68	.74	43	.74	44	.74	44	.74	45	.69	39	.69	39	.69	39	.69	39	.716	46.0	.670
11th	.55	35	.55	36	.55	41	.51	40	.51	43	.50	36	.46	37	.48	38	.50	37	.50	37	.50	38	.547	38.3	.521
12th	.55	38	.56	36	.56	33	.56	34	.60	33	.60	34	.63	36	.65	38	.65	38	.65	39	.65	39	.543	35.2	.525
13th	.70	36	.69	37	.70	40	.68	36	.65	30	.60	30	.56	28	.56	28	.56	27	.56	28	.57	26	.659	33.7	.645
14th	.51	21	.51	17	.51	21	.50	21	.48	23	.48	19	.45	21	.45	19	.45	15	.45	15	.43	20	.504	23.7	.517
15th	.37	20	.37	17	.37	16	.35	15	.35	15	.40	9	.40	12	.45	20	.45	13	.45	15	.49	14	.371	16.2	.403
16th	.55	19	.54	16	.54	12	.60	19	.60	18	.60	20	.60	18	.61	18	.62	22	.62	20	.62	11	.557	14.7	.594
17th	.55	18	.55	17	.55	16	.55	19	.55	13	.55	26	.55	25	.59	27	.59	26	.56	19	.56	24	.569	16.5	.601
18th	.62	21	.62	18	.62	19	.64	20	.65	21	.65	20	.62	19	.60	14	.60	14	.59	11	.59	11	.601	16.4	.633
19th	.56	20	.60	19	.60	19	.65	20	.65	21	.65	21	.65	22	.69	24	.69	15	.69	13	.69	12	.606	15.2	.641
20th	.64	18	.64	17	.64	21	.55	19	.55	25	.53	20	.49	16	.50	22	.50	18	.50	15	.50	13	.620	14.8	.657
21st	.22	24	.19	25	.19	29	.20	26	.20	25	.20	25	.20	23	.20	26	.20	27	.19	27	.19	20	.287	22.4	.303
22d	.28	34	.28	31	.26	28	.26	34	.26	32	.26	30	.26	25	.25	29	.25	26	.25	28	.25	22	.265	27.9	.267
*23d	*.86	31	*.86	30	*.86	28	*.86	27	*.86	29	*.86	30	*.86	26	*.89	30	*.92	33	*.94	30	*.94	26	*.947	23.9	*.959
*24th	.00	32	.00	29	.00	24	.00	30	.00	30	.00	32	.00	30	.00	29	.00	30	.00	30	.00	24	*.979	28.4	*.979
*25th	*.94	25	*.94	31	*.95	32	*.94	31	*.93	32	*.95	33	*.95	33	*.95	30	.00	28	.00	30	.00	30	*.955	28.9	*.954
26th	.16	29	.17	32	.17	30	.20	37	.21	31	.20	32	.20	30	.20	30	.20	37	.20	31	.20	31	.121	30.0	.117
27th	.19	30	.19	32	.19	33	.20	27	.20	31	.20	31	.20	32	.21	31	.21	31	.22	31	.22	31	.200	30.5	.194
28th	.25	23	.25	23	.25	21	.25	23	.25	24	.25	29	.25	23	.30	25	.30	24	.31	24	.31	21	.247	23.9	.259
29th	.38	24	.40	30	.44	30	.45	24	.45	30	.45	28	.50	27	.50	29	.50	27	.50	26	.50	32	.392	23.8	.404
30th	.50	21	.50	21	.50	21	.50	24	.50	23	.51	25	.51	23	.51	24	.50	26	.50	27	.50	26	.500	21.5	.518
31st	.60	25	.60	27	.60	25	.60	26	.60	31	.60	31	.60	31	.58	31	.55	25	.55	27	.55	27	.553	25.2	.561
Means	.459	31.7	.461	32.1	.462	31.7	.462	30.9	.465	31.4	.467	31.9	.465	30.8	.469	30.9	.471	30.1	.467	29.6	.469	28.9	.461	29.8	
B. at 32°	29.451		29.451		29.454		29.455		29.457		29.459		29.459		29.462		29.467		29.464		29.468		29.458		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR, In February, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.55	27	.55	22	.50	21	.50	20	.50	21	.50	20	.50	20	.50	22	.51	26	.51	17	.49	18	.45	25	.50	25
2d	.62	28	.62	29	.62	23	.62	21	.65	20	.65	17	.65	20	.65	22	.72	25	.72	24	.72	26	.72	25	.70	24
3d	.52	26	.48	26	.46	21	.43	20	.43	21	.41	21	.39	20	.38	24	.38	25	.40	19	.40	18	.40	18	.40	23
4th	.60	25	.60	25	.62	24	.62	24	.67	16	.67	15	.67	21	.69	21	.70	27	.70	20	.70	15	.68	16	.68	20
5th	.52	16	.50	16	.50	15	.47	11	.40	6	.38	5	.35	5	.33	15	.34	16	.30	16	.30	14	.25	17	.25	15
6th	.30	15	.30	17	.30	16	.30	10	.40	9	.43	8	.43	4	.50	19	.50	18	.50	18	.51	12	.52	15	.55	20
7th	.65	18	.66	17	.66	16	.66	14	.66	18	.67	19	.67	21	.68	20	.80	21	.80	22	.80	22	.80	15	.90	17
8th	1.22	26	1.22	25	1.22	24	1.22	24	1.40	17	1.40	25	1.40	24	1.40	26	1.40	20	1.40	9	1.35	9	1.30	13	1.22	14
9th	.60	24	.60	24	.60	27	.60	26	.67	16	.65	8	.60	6	.60	16	.60	18	.60	18	.60	20	.60	25	.60	16
10th	.45	17	.45	14	.43	16	.47	18	.60	24	.55	16	.60	15	.65	15	.65	12	.68	4	.75	10	.78	12	.79	16
11th	.88	21	.88	20	.86	20	.86	17	.85	16	.83	18	.80	18	.80	23	.80	24	.80	22	.80	20	.80	22	.77	24
12th	1.03	22	1.04	20	1.07	19	1.08	21	1.10	19	1.15	20	1.20	24	1.20	24	1.20	23	1.20	23	1.25	27	1.25	29	1.23	26
13th	1.15	22	1.15	21	1.10	20	1.10	18	1.05	22	1.03	23	1.00	23	.96	21	.90	21	.90	21	.90	21	.88	26	.90	35
14th	.94	21	.94	18	.94	17	.95	16	.93	24	.95	20	.97	20	.97	24	.95	20	.95	23	.90	24	.85	24	.85	27
15th	.40	27	.40	28	.35	27	.35	26	.40	25	.46	21	.46	23	.46	24	.35	24	.35	24	.40	25	.40	26	.46	28
16th	.86	22	.88	22	.88	19	.88	19	.90	20	.90	31	.94	29	.95	30	.99	29	.99	29	.99	29	.99	27	.99	33
17th	1.01	35	1.02	33	1.04	32	1.04	33	1.00	31	1.02	33	1.02	31	1.04	32	1.03	32	1.02	36	1.02	36	1.00	35	.85	31
*18th	.39	32	.30	29	.25	30	.20	27	.15	26	.13	27	.10	28	.05	29	.02	33	.00	31	*.95	30	*.93	31	*.93	37
*19th	*.90	34	*.90	35	*.91	33	*.91	33	*.91	32	*.91	31	*.91	31	*.92	35	*.88	35	*.86	33	*.84	30	*.90	28	*.90	29
20th	.14	34	.14	30	.14	31	.17	33	.20	34	.22	33	.25	33	.27	30	.25	30	.27	30	.27	29	.30	29	.30	29
21st	.25	30	.23	28	.21	29	.18	30	.15	29	.12	27	.10	28	.10	30	.11	31	.15	33	.16	33	.25	31	.25	31
22d	.32	31	.35	33	.35	35	.35	32	.35	31	.35	30	.40	30	.40	31	.41	32	.44	25	.45	28	.48	28	.48	31
23d	.62	32	.63	30	.63	28	.63	27	.63	25	.63	23	.64	23	.66	24	.62	23	.65	25	.65	26	.68	31	.68	32
24th	.82	27	.83	27	.85	28	.86	28	.86	27	.86	28	.90	28	.95	30	1.05	33	1.05	33	1.05	27	1.06	28	1.10	29
25th	1.23	23	1.21	21	1.21	21	1.21	23	1.15	24	1.16	25	1.17	26	1.15	29	1.08	26	1.08	28	1.06	28	1.05	33	1.00	31
26th	.50	17	.49	19	.45	18	.45	18	.44	18	.42	20	.42	20	.38	20	.40	20	.40	20	.35	24	.35	22	.34	23
27th	.50	23	.50	23	.55	24	.55	25	.57	25	.57	26	.60	23	.60	28	.60	28	.62	21	.60	18	.60	23	.60	23
28th	.60	18	.60	18	.60	16	.60	20	.60	19	.60	18	.60	20	.60	23	.60	27	.60	25	.60	22	.58	24	.60	25
Means	.627	24.7	.624	24.0	.618	23.2	.616	22.6	.629	22.0	.629	21.7	.634	21.9	.637	24.5	.637	25.0	.641	23.2	.638	22.9	.637	24.2	.636	25.5
B. at 32°	29.637		29.636		29.632		29.632		29.646		29.647		29.651		29.647		29.646		29.655		29.653		29.648		29.644	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.50	26	.50	25	.52	22	.51	24	.51	26	.51	30	.51	27	.61	26	.60	29	.62	30	.62	27	.524	24.0	.536
2d	.70	23	.71	24	.70	27	.70	28	.70	28	.70	25	.67	25	.66	26	.66	26	.66	27	.66	24	.674	24.5	.684
3d	.40	24	.45	23	.45	22	.48	24	.50	27	.54	26	.57	26	.60	27	.60	27	.60	25	.60	23	.469	23.2	.483
4th	.68	17	.65	12	.63	12	.62	14	.62	16	.62	20	.63	21	.60	16	.60	19	.60	20	.55	19	.642	19.0	.667
5th	.25	16	.23	15	.24	13	.24	20	.24	20	.26	27	.28	24	.28	15	.28	14	.32	11	.33	15	.327	14.9	.363
6th	.56	17	.57	21	.58	20	.63	20	.65	24	.65	25	.65	24	.65	24	.65	27	.68	7	.70	8	.521	16.6	.553
7th	.90	16	1.15	16	1.05	21	1.07	21	1.12	27	1.15	28	1.16	27	1.23	25	1.23	23	1.25	22	1.30	22	.917	20.3	.938
8th	1.22	14	1.22	18	1.22	17	1.16	16	1.11	20	1.09	23	1.06	21	1.00	24	1.00	19	.95	17	.90	18	1.212	19.3	1.236
9th	.60	14	.60	22	.60	20	.58	19	.54	19	.54	19	.48	19	.46	17	.46	22	.45	20	.43	18	.569	18.9	.595
10th	.80	24	.82	30	.93	18	.91	31	.91	32	.91	30	.91	25	.95	23	.95	25	.95	22	.93	20	.742	19.5	.766
11th	.77	22	.80	24	.80	24	.85	25	.87	24	.90	23	.90	21	.95	22	.95	26	1.00	24	1.00	23	.855	21.8	.874
12th	1.27	28	1.30	30	1.30	28	1.33	29	1.33	27	1.33	27	1.28	22	1.28	21	1.26	24	1.24	25	1.20	28	1.213	24.4	1.223
13th	.90	36	.90	25	.90	24	.90	24	.95	30	.95	35	.95	32	.95	32	.95	25	.95	22	.95	22	.970	25.0	.979
14th	.80	26	.78	31	.73	28	.73	28	.73	30	.73	31	.73	31	.60	28	.58	30	.50	30	.50	30	.812	25.1	.821
15th	.53	24	.59	30	.60	30	.68	30	.70	28	.75	32	.75	30	.76	32	.76	30	.80	25	.80	26	.540	26.9	.544
16th	.97	34	.97	38	.99	35	.99	33	1.00	40	1.00	42	1.00	37	1.00	35	1.00	35	1.01	35	1.01	37	.962	30.8	.956
17th	.87	32	.84	32	.80	28	.75	23	.70	26	.68	28	.65	31	.60	31	.56	33	.50	32	.45	33	.855	31.6	.847
*18th	*.93	37	*.93	37	*.93	45	*.98	38	*.95	31	*.95	31	*.95	29	*.94	38	*.94	38	*.92	35	*.91	34	.030	32.6	.018
*19th	*.95	30	.00	34	.00	36	.03	38	.05	38	.05	38	.05	36	.06	36	.10	30	.11	35	.12	35	*.965	33.5	*.952
20th	.25	34	.25	35	.25	33	.27	33	.27	29	.27	35	.27	33	.25	32	.25	32	.25	32	.25	31	.240	31.8	.232
21st	.25	31	.25	31	.25	32	.29	32	.29	31	.29	28	.27	27	.27	29	.27	28	.27	34	.30	33	.219	30.2	.214
22d	.48	32	.51	34	.52	32	.55	34	.55	35	.56	32	.56	28	.55	30	.55	32	.60	32	.60	32	.465	31.3	.457
23d	.68	33	.70	32	.70	32	.70	28	.74	27	.74	28	.75	29	.76	28	.77	28	.77	26	.80	24	.686	27.7	.688
24th	1.10	27	1.10	25	1.10	26	1.15	25	1.15	27	1.19	28	1.23	31	1.24	32	1.24	31	1.24	30	1.24	29	1.051	28.5	1.051
25th	1.00	30	.95	32	.92	30	.90	24	.84	20	.89	20	.70	19	.65	15	.61	14	.57	18	.54	14	.972	23.9	.984
26th	.34	21	.34	22	.34	22	.40	26	.40	27	.40	26	.43	26	.43	23	.45	23	.48	20	.48	21	.412	21.5	.430
27th	.60	23	.60	24	.60	25	.60	20	.65	25	.65	26	.65	23	.65	22	.62	21	.61	21	.60	21	.595	23.4	.608
28th	.63	26	.65	25	.62	25	.60	18	.59	19	.55	20	.55	22	.56	24	.58	24	.58	22	.58	23	.595	21.8	.613
Means	.640	25.6	.656	26.7	.655	26.0	.664	25.9	.666	26.9	.673	28.0	.664	26.6	.662	26.2	.660	26.2	.660	25.0	.655	24.6	.644	24.7	
B. at 32°	29.648		29.661		29.662		29.671		29.671		29.674		29.669		29.668		29.666		29.669		29.666		29.654		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR, In March, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.56	21	.55	20	.55	21	.56	20	.55	20	.55	20	.55	20	.50	20	.50	22	.50	20	.50	22	.46	20	.46	23
2d	.56	20	.56	18	.60	18	.61	19	.65	18	.65	17	.70	12	.70	15	.70	21	.70	17	.72	19	.74	22	.75	26
3d	.92	16	.94	14	.95	14	.97	15	.99	14	1.00	15	1.05	16	1.10	18	1.15	20	1.16	17	1.17	20	1.20	22	1.20	1
4th	1.25	13	1.35	12	1.35	14	1.36	12	1.38	13	1.38	13	1.40	14	1.40	16	1.45	23	1.45	23	1.45	15	1.45	15	1.43	13
5th	1.27	15	1.26	17	1.24	19	1.24	17	1.24	15	1.20	18	1.20	20	1.20	21	1.15	24	1.15	24	1.12	23	1.10	22	1.07	25
6th	1.00	15	.95	11	.95	11	.95	12	.95	13	.95	13	.95	14	.95	15	.95	24	.95	16	.93	14	.92	13	.90	11
7th	.80	21	.80	20	.80	21	.76	20	.75	17	.75	17	.72	11	.72	13	.72	12	.70	16	.72	19	.67	20	.65	19
8th	.60	10	.60	7	.60	8	.60	8	.60	7	.60	6	.60	8	.60	9	.64	11	.65	12	.66	21	.68	16	.68	15
9th	.72	19	.72	5	.72	4	.72	3	.72	10	.72	17	.72	10	.72	15	.74	20	.77	19	.77	19	.80	19	.80	18
10th	.84	7	.84	4	.84	2	.84	0	.84	2	.84	4	.84	0	.85	11	.87	8	.87	11	.87	10	.87	10	.85	8
11th	.80	11	.80	10	.80	9	.80	8	.80	7	.80	5	.80	7	.80	9	.78	12	.80	14	.80	13	.80	13	.80	16
12th	.70	3	.71	1	.71	0	.71	0	.71	3	.72	3	.72	5	.72	6	.74	9	.71	8	.65	13	.62	15	.62	7
13th	.53	2	.52	1	.52	0	.52	0	.52	0	.52	0	.52	2	.53	6	.54	12	.54	10	.54	10	.54	11	.52	18
14th	.50	8	.50	6	.50	4	.50	4	.50	−14	.48	−14	.45	5	.45	15	.45	12	.45	12	.42	14	.42	14	.41	14
15th	.41	7	.41	6	.41	2	.41	0	.40	− 1	.41	4	.42	7	.43	11	.45	10	.47	20	.47	21	.47	21	.50	21
16th	.65	11	.69	15	.69	13	.70	11	.72	12	.72	14	.76	16	.80	17	.82	21	.84	22	.84	17	.84	16	.85	20
17th	.96	11	.96	10	.96	11	.96	10	1.00	9	1.00	10	1.05	12	1.06	16	1.06	16	1.06	18	1.06	19	1.10	16	1.10	23
18th	1.10	4	1.07	2	1.07	1	1.07	2	1.07	3	.90	9	.90	12	.90	14	.90	14	.85	14	.85	13	.73	13	.82	27
19th	.55	27	.55	25	.55	25	.55	24	.55	24	.57	22	.60	22	.62	21	.63	21	.65	23	.70	27	.80	24	.82	27
20th	1.11	22	1.12	22	1.10	24	1.07	20	1.06	19	1.08	15	1.08	16	1.05	18	1.05	20	1.02	19	.98	23	.90	23	.87	25
21st	.52	15	.52	16	.52	17	.66	18	.60	19	.60	18	.60	20	.60	21	.72	31	.72	30	.74	29	.74	27	.70	26
22d	.46	22	.46	21	.46	23	.46	24	.47	20	.49	20	.54	19	.56	24	.62	30	.69	31	.69	27	.69	27	.72	25
23d	.88	20	.88	19	.85	17	.85	17	.85	17	.85	19	.84	17	.83	17	.80	23	.80	18	.76	13	.81	18	.83	21
24th	.85	17	.82	15	.82	13	.82	14	.82	14	.82	13	.82	11	.80	20	.82	22	.82	21	.85	16	.86	14	.86	13
25th	.95	11	.97	8	.97	6	.97	6	.97	5	.97	7	.97	6	.97	10	1.00	12	1.02	12	1.04	16	1.05	23	1.09	23
26th	1.06	11	1.06	12	1.06	10	1.06	11	1.06	7	1.06	6	1.05	6	1.05	10	1.05	16	1.05	10	1.05	12	1.03	16	1.02	12
27th	.85	11	.85	11	.85	5	.85	4	.85	−3	.82	−10	.82	−12	.80	−8	.80	0	.80	7	.80	12	.80	15	.79	13
28th	.48	2	.45	0	.43	0	.42	0	.41	1	.40	3	.40	9	.40	15	.40	18	.40	20	.38	16	.38	18	.37	18
29th	.22	10	.20	8	.20	0	.20	−10	.18	9	.18	9	.16	1	.16	7	.16	8	.16	10	.16	11	.16	12	.16	15
30th	.30	2	.35	0	.38	0	.42	− 3	.44	3	.47	1	.50	5	.51	9	.54	10	.55	14	.56	14	.56	15	.60	18
31st	.64	12	.61	10	.60	7	.58	6	.58	6	.53	8	.50	7	.55	9	.55	12	.53	14	.51	17	.50	15	.50	3
Means	.743	12.8	.744	11.2	.744	10.3	.748	9.4	.750	9.3	.748	9.5	.750	10.2	.753	13.5	.766	16.6	.770	16.8	.766	17.3	.768	17.6	.763	17.1
B. at 32°	29.784		29.789		29.792		29.798		29.800		39.798		29.798		29.793		29.798		29.802		29.796		29.798		29.794	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.49	25	.49	25	.49	26	.50	26	.50	26	.52	25	.55	25	.52	22	.52	21	.55	21	.55	19	.519	22.1	.536
2d	.75	22	.76	23	.77	22	.78	20	.80	20	.80	21	.80	22	.89	23	.90	22	.90	20	.90	20	.737	19.9	.760
3d	1.18	6	1.21	19	1.23	8	1.23	9	1.25	10	1.25	10	1.30	10	1.32	13	1.34	14	1.34	14	1.35	12	1.158	13.6	1.197
4th	1.45	16	1.44	10	1.42	9	1.42	8	1.40	16	1.40	21	1.40	21	1.40	19	1.40	18	1.35	17	1.32	18	1.396	15.4	1.430
5th	1.07	25	1.07	24	1.05	20	1.05	17	1.05	19	1.05	20	1.05	21	1.05	20	1.05	20	1.03	16	1.00	16	1.123	19.9	1.146
6th	.90	9	.90	12	.90	12	.90	12	.90	13	.90	13	.90	14	.86	12	.86	12	.85	19	.84	18	.917	13.7	.957
7th	.65	19	.65	21	.65	22	.65	20	.65	20	.65	19	.65	12	.65	11	.64	9	.63	7	.62	12	.694	16.6	.726
8th	.68	17	.68	18	.68	15	.70	15	.70	11	.70	14	.70	14	.72	14	.72	13	.72	12	.73	10	.660	12.1	.705
9th	.80	18	.80	18	.80	19	.80	17	.80	17	.82	17	.83	15	.85	11	.85	15	.85	12	.85	10	.779	14.5	.816
10th	.85	9	.83	10	.83	10	.83	9	.83	9	.83	8	.83	10	.83	10	.83	10	.83	10	.83	9	.842	7.5	.897
11th	.80	16	.81	16	.81	16	.82	15	.82	14	.82	12	.82	10	.80	10	.80	7	.74	7	.70	3	.797	10.8	.844
12th	.65	17	.65	12	.65	14	.65	4	.65	6	.65	8	.65	8	.64	10	.55	3	.55	2	.53	2	.661	6.6	.720
13th	.55	15	.55	13	.55	15	.56	14	.56	10	.56	11	.56	10	.55	10	.55	10	.53	10	.52	10	.537	8.3	.590
14th	.41	16	.41	17	.41	16	.41	16	.41	14	.41	17	.41	15	.40	14	.40	13	.40	13	.40	10	.438	10.0	.487
15th	.50	17	.57	26	.57	23	.56	23	.56	21	.56	21	.56	18	.55	24	.55	17	.55	19	.55	14	.489	14.7	.526
16th	.85	19	.90	24	.90	23	.90	22	.90	21	.90	21	.90	20	.90	26	.92	20	.90	16	.92	14	.825	18.0	.853
17th	1.10	10	1.10	20	1.10	22	1.10	16	1.10	12	1.10	9	1.10	8	1.12	21	1.14	20	1.13	7	1.11	5	1.064	13.8	1.103
18th	.70	23	.70	23	.65	21	.65	20	.65	18	.64	18	.64	22	.60	22	.57	25	.57	23	.55	27	.808	14.4	.845
19th	.86	22	1.05	20	.95	23	.98	26	.99	26	1.05	23	1.07	26	1.09	24	1.10	20	1.10	20	1.10	22	.812	23.5	.825
20th	.85	25	.80	23	.75	20	.70	21	.66	21	.65	20	.64	19	.57	16	.57	15	.54	15	.53	12	.865	19.7	.889
21st	.70	32	.68	30	.65	30	.63	22	.62	20	.60	20	.58	18	.57	27	.51	31	.49	26	.47	25	.614	23.7	.627
22d	.70	27	.79	29	.80	23	.82	24	.84	22	.85	25	.85	23	.85	25	.85	25	.85	27	.86	22	.682	24.4	.692
23d	.83	22	.83	25	.83	24	.85	27	.85	30	.85	29	.85	28	.85	26	.86	21	.86	20	.86	13	.839	20.9	.860
24th	.86	14	.89	14	.90	14	.93	18	.94	17	.94	18	.95	18	.96	19	.96	17	.96	14	.96	12	.876	15.7	.909
25th	1.09	29	1.10	29	1.10	19	1.09	13	1.07	18	1.07	17	1.07	14	1.07	16	1.07	17	1.07	16	1.07	17	1.034	14.6	1.071
26th	1.02	14	1.00	14	1.00	15	.97	10	.97	12	.95	10	.95	10	.95	12	.90	7	.90	5	.90	2	1.007	10.4	1.055
27th	.78	16	.77	10	.77	12	.71	10	.67	4	.65	12	.64	9	.63	14	.57	10	.50	5	.50	3	.744	6.3	.804
28th	.37	19	.38	16	.38	14	.37	15	.37	11	.37	13	.37	13	.36	9	.30	2	.28	3	.24	−1	.379	9.7	.429
29th	.15	14	.15	14	.19	16	.21	15	.24	12	.24	10	.27	11	.30	12	.36	9	.30	9	.30	4	.209	9.0	.260
30th	.63	19	.65	16	.65	12	.65	9	.65	12	.69	5	.69	6	.65	14	.67	14	.67	14	.65	15	.560	9.2	.611
31st	.50	−1	.48	7	.45	6	.45	8	.45	9	.45	7	.48	12	.48	13	.48	11	.48	10	.50	20	.516	9.5	.567
Means	.765	17.8	.777	18.6	.770	17.5	.770	16.2	.769	15.8	.772	16.0	.776	15.5	.774	16.7	.767	15.1	.755	13.8	.749	12.7	.761	14.5	
B. at 32°	29.794		29.803		29.800		29.802		29.803		29.805		29.810		29.806		29.803		29.794		29.791		29.798		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR, In April, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.58	−2	.60	−7	.63	1	.68	1	.70	1	.69	3	.70	4	.72	7	.75	8	.75	6	.78	10	.80	10	.83	10
2d	.83	17	.83	6	.83	6	.83	8	.83	5	.85	1	.84	10	.83	16	.83	16	.83	18	.80	17	.80	17	.80	21
3d	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.27	25
4th	...	...	...	...	...	...	...	...	.33	23	.33	23	.33	21	.33	17	.33	21	.33	27	.35	26	.35	26	.34	27
5th	.35	26	.33	26	.35	28	.33	28	.35	28	.35	29	.35	27	.35	31	.37	31	.37	31	.37	30	.37	33	.37	27
6th	.52	23	.63	24	.65	25	.68	26	.70	22	.71	20	.75	21	.79	25	.84	26	.86	27	.90	24	.94	26	.93	26
7th	1.15	23	1.15	21	1.15	18	1.15	15	1.20	19	1.20	20	1.20	25	1.18	22	1.26	27	1.33	29	1.33	29	1.33	29	1.21	27
8th	1.15	30	1.16	32	1.15	33	1.15	33	1.12	28	1.12	18	1.12	17	1.10	16	1.10	16	1.10	14	1.10	13	1.10	23	1.10	22
9th	1.10	22	1.10	22	1.10	22	1.08	21	1.04	21	1.07	22	1.06	20	1.05	25	1.05	31	1.05	30	1.05	31	1.05	34	.98	37
10th	1.15	31	1.15	31	1.15	31	1.15	31	1.15	27	1.15	26	1.15	23	1.21	30	1.25	36	1.25	34	1.25	34	1.24	23	1.25	23
11th	1.33	27	1.33	30	1.33	33	1.32	27	1.20	13	1.18	15	1.18	16	1.15	18	1.13	22	1.13	23	1.13	23	1.10	30	1.08	30
12th	.85	27	.85	23	.84	24	.84	20	.87	18	.89	17	.96	19	.96	23	.98	34	.98	37	.98	36	1.00	32	1.00	35
13th	1.04	30	1.04	34	1.03	35	1.03	34	1.03	24	1.02	24	1.00	28	1.00	30	1.00	31	.95	31	.95	31	.94	34	.95	33
14th	.80	25	.80	23	.80	21	.80	23	.80	24	.84	30	.84	29	.84	29	.84	23	.85	35	.88	38	.90	38	.90	39
15th	1.00	24	1.00	24	1.02	21	1.03	20	1.04	18	1.04	18	1.03	23	1.05	35	1.05	29	1.05	31	1.05	33	1.05	33	1.05	34
16th	.90	25	.90	25	.90	24	.93	25	.95	24	.98	31	1.03	35	1.06	38	1.10	39	1.10	39	1.10	40	1.10	42	1.13	39
17th	1.24	31	1.24	29	1.23	26	1.21	25	1.21	26	1.21	28	1.20	34	1.20	34	1.20	35	1.20	36	1.18	37	1.18	38	1.18	39
18th	1.14	32	1.14	26	1.14	25	1.14	23	1.15	19	1.15	24	1.16	19	1.20	35	1.20	31	1.23	31	1.22	34	1.25	35	1.25	40
19th	1.30	33	1.34	30	1.34	32	1.34	20	1.31	18	1.31	19	1.31	23	1.31	31	1.31	32	1.30	33	1.30	35	1.30	36	1.30	37
20th	1.30	26	1.30	24	1.30	24	1.30	20	1.35	20	1.34	19	1.36	21	1.35	23	1.36	36	1.36	34	1.36	34	1.35	35	1.35	35
21st	1.24	25	1.16	23	1.16	22	1.16	21	1.15	20	1.14	24	1.12	32	1.12	31	1.12	34	1.12	33	1.08	33	1.05	33	1.06	37
22d	.95	25	.95	22	.95	21	.95	23	.95	22	.95	22	.95	28	.95	29	.95	36	.95	36	.95	38	.95	38	.93	38
23d	.90	28	.90	29	.90	25	.90	25	.90	28	.90	28	.92	29	.94	30	.95	36	.97	37	.97	40	.97	40	.98	46
24th	.98	28	.96	25	.95	27	.92	26	.92	25	.92	29	.92	34	.90	32	.90	39	.90	38	.90	40	.88	43	.90	39
25th	.97	30	.97	28	.97	27	.97	25	.97	27	.97	29	.97	30	.97	30	1.00	32	1.00	34	1.00	36	1.00	37	1.00	39
26th	.95	26	.95	25	.95	24	.96	24	.96	27	.97	30	1.01	33	1.03	37	1.05	38	1.12	37	1.15	40	1.20	39	1.20	38
27th	1.28	37	1.28	37	1.31	28	1.29	30	1.25	33	1.25	35	1.25	35	1.25	33	1.15	36	1.15	40	1.12	40	1.09	40	1.09	40
28th	1.07	35	1.05	34	1.07	35	1.07	37	1.09	36	1.10	32	1.12	35	1.15	36	1.19	37	1.17	38	1.17	40	1.20	43	1.20	42
29th	1.03	34	1.03	36	1.00	37	1.00	36	.98	32	.95	32	.95	35	.93	33	.90	37	.92	39	.90	40	.90	38	.87	38
30th	.90	33	.90	32	.90	30	.90	32	.90	32	.90	31	.95	31	.97	32	.99	37	.99	38	.99	39	1.01	40	1.00	43
Means	.962	26.4	.963	25.3	.964	25.0	.964	24.2	.962	22.8	.964	23.5	.971	25.4	.976	28.1	.984	30.4	.989	31.4	.988	32.2	.990	33.0	.983	33.5
B. at 32°	29.968		29.971		29.973		29.975		29.978		29.977		29.979		29.977		29.979		29.981		29.978		29.978		29.970	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.82	10	.85	11	.90	11	.90	12	.90	14	.90	15	.92	17	.92	17	.92	15	.92	15	.92	11	.795	8.3	.848
2d	.73	20	.72	19	.71	22	.70	22	.69	25	.64	23	.65	24	...	...	...	...	...	...	...	...	.748	17.0	.779
3d	.28	25	.29	25	.31	23	.33	26	.35	27	.36	25	.39	27	.40	25	.36	25	.34	26	.33	17	.379	24.8	.388
4th	.38	25	.36	25	.38	27	.39	37	.39	38	.37	34	.38	34	.38	34	.36	35	.36	30	.33	30	.351	26.6	.356
5th	.37	28	.37	28	.40	29	.42	27	.44	29	.45	27	.47	28	.47	25	.51	27	.51	26	.50	20	.397	27.9	.398
6th	.93	27	.98	28	1.00	29	1.08	29	1.08	27	1.10	27	1.11	30	1.10	27	1.14	23	1.14	20	1.16	21	.905	25.1	.914
7th	1.18	25	1.15	25	1.15	26	1.16	23	1.16	22	1.16	21	1.16	24	1.16	23	1.16	24	1.16	25	1.16	27	1.192	23.7	1.205
8th	1.10	22	1.10	22	1.10	23	1.10	23	1.10	27	1.10	31	1.10	33	1.13	31	1.13	27	1.10	22	1.09	23	1.113	24.1	1.125
9th	1.00	36	1.04	34	1.05	33	1.07	33	1.09	29	1.10	27	1.10	32	1.15	35	1.15	36	1.15	33	1.18	30	1.077	29.0	1.076
10th	1.25	24	1.26	25	1.28	26	1.29	27	1.30	33	1.30	30	1.30	34	1.30	...	1.32	...	1.32	...	1.32	...	1.239	29.1	1.238
11th	1.08	37	1.05	35	1.03	32	1.00	30	1.00	30	1.00	29	1.00	30	1.00	30	.93	32	.90	35	.83	35	1.100	27.6	1.103
12th	1.02	36	1.04	37	1.05	36	1.03	34	1.04	35	1.04	30	1.04	28	1.02	29	1.00	28	1.03	29	1.03	29	.972	29.4	.969
13th	.95	34	.93	35	.90	36	.90	33	.88	33	.86	33	.86	34	.80	31	.80	32	.80	33	.80	32	.936	31.9	.927
14th	.90	37	.90	35	.93	27	.95	35	.96	33	.98	39	.98	35	.98	33	.98	32	1.00	33	1.00	35	.894	31.3	.886
15th	1.05	33	1.05	35	1.05	36	1.07	36	1.09	36	1.09	38	1.07	36	1.05	35	1.03	32	1.00	31	1.00	32	1.042	30.1	1.038
16th	1.13	40	1.13	40	1.15	39	1.10	42	1.12	44	1.22	41	1.23	39	1.22	33	1.23	34	1.25	32	1.25	31	1.092	35.0	1.075
17th	1.18	38	1.15	38	1.15	38	1.12	31	1.12	35	1.12	35	1.12	38	1.12	35	1.12	33	1.12	32	1.14	31	1.172	33.4	1.158
18th	1.25	37	1.28	35	1.28	33	1.32	34	1.34	32	1.35	34	1.35	34	1.32	35	1.30	35	1.30	32	1.30	34	1.240	31.2	1.233
19th	1.30	36	1.30	36	1.30	34	1.30	35	1.30	32	1.30	32	1.30	30	1.30	29	1.30	27	1.30	24	1.30	24	1.307	29.9	1.303
20th	1.35	34	1.35	34	1.32	33	1.30	33	1.30	33	1.30	32	1.30	34	1.25	33	1.25	34	1.18	35	1.18	35	1.311	30.0	1.307
21st	1.05	37	1.05	38	1.05	37	1.00	35	1.00	39	1.00	36	1.00	27	1.00	35	1.00	30	1.00	28	1.00	24	1.076	30.6	1.070
22d	.93	37	.93	37	.90	38	.90	35	.90	39	.90	37	.90	38	.88	36	.88	34	.88	33	.90	31	.926	32.2	.916
23d	.97	43	.97	40	.98	37	1.02	39	1.02	41	1.02	43	1.02	41	1.00	40	1.00	36	1.00	31	.95	29	.960	35.0	.943
24th	.90	37	.90	38	.90	37	.92	37	.93	35	.95	35	.95	35	.95	33	.95	32	.96	32	.96	30	.926	33.6	.912
25th	1.00	40	1.00	39	1.00	38	1.00	37	1.00	38	.96	38	.96	38	...	...	...	...	...	...	...	...	.979	33.5	.965
26th	1.20	35	1.20	37	1.22	39	1.25	36	1.25	37	1.25	36	1.25	37	1.28	36	1.25	36	1.25	36	1.25	36	1.129	34.2	1.113
27th	1.09	38	1.09	37	1.05	38	1.02	39	1.05	39	1.05	40	1.06	39	1.07	39	1.07	39	1.07	35	1.07	35	1.144	36.8	1.122
28th	1.19	41	1.19	39	1.18	37	1.14	35	1.14	36	1.14	38	1.14	38	1.14	37	1.10	38	1.07	38	1.04	34	1.130	37.1	1.108
29th	.84	40	.84	38	.84	37	.80	37	.80	37	.82	36	.83	36	.85	35	.85	33	.87	34	.90	34	.900	36.0	.880
30th	1.00	41	1.05	40	1.05	38	1.03	38	1.03	39	1.03	39	1.03	38	1.03	37	1.03	36	1.03	34	1.03	35	.985	36.0	.965
Means	.981	33.1	.984	32.8	.986	32.2	.986	32.4	.992	33.1	.995	32.7	.999	32.9	.994	32.0	.991	31.1	.985	30.0	.981	28.9	.981	29.7	
B. at 32°	29.969		29.973		29.976		29.976		29.980		29.983		29.987		29.985		29.984		29.981		29.980		29.977		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,

In May, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	1.00	36	1.00	37	1.00	36	1.00	35	1.00	38	1.00	37	1.00	37	1.00	41	1.00	34	1.00	35	1.00	36	.95	34	.95	37
2d	.95	34	.92	28	.90	33	.90	51	.90	52	.90	57	.90	58	.90	48	.90	37	.90	35	.90	35	.90	35	.90	30
3d	.90	34	.90	38	.90	35	.90	38	.87	41	.87	55	.87	61	.87	55	.87	57	.85	58	.80	62	.75	60	.72	61
4th	.46	35	.46	28	.44	30	.42	44	.41	51	.41	58	.41	57	.41	58	.40	56	.40	56	.40	57	.34	52	.29	50
5th	.27	30	.27	30	.30	31	.30	54	.30	56	.32	56	.34	57	.37	55	.37	54	.40	42	.45	40	.46	37	.48	38
6th	.65	30	.65	30	.65	29	.65	30	.69	37	.75	57	.76	56	.76	57	.76	46	.76	46	.76	45	.75	44	.73	46
7th	.75	40	.77	48	.77	54	.78	56	.80	61	.80	64	.82	66	.85	68	.96	54	.97	52	1.00	50	1.00	50	1.00	47
8th	1.20	46	1.20	44	1.24	45	1.24	47	1.25	47	1.25	48	1.28	56	1.28	57	1.30	60	1.30	61	1.30	61	1.30	62	1.30	64
9th	1.33	50	1.33	52	1.33	49	1.33	51	1.35	55	1.33	56	1.30	55	1.27	55	1.27	62	1.25	61	1.23	59	1.23	60	1.20	57
10th	.87	57	.85	56	.85	57	.85	59	.85	59	.85	57	.85	58	.85	59	.84	60	.85	56	.85	58	.85	57	.85	58
11th	.78	61	.78	62	.75	62	.75	58	.75	58	.75	57	.75	57	.75	56	.76	57	.76	56	.72	58	.70	61	.70	60
12th	.71	48	.72	49	.74	50	.75	46	.79	47	.80	50	.80	51	.80	53	.85	56	.86	55	.87	53	.88	58	.90	59
13th	1.02	57	1.02	57	1.03	56	1.03	56	1.02	54	1.02	54	1.04	56	1.04	56	1.06	56	1.06	58	1.06	56	1.07	60	1.07	61
14th	.87	52	.87	54	.87	52	.87	57	.87	50	.87	52	.87	48	.87	51	.87	53	.87	52	.86	52	.84	51	.85	55
15th	.92	52	.92	54	.92	53	.92	56	.92	57	.92	56	.92	55	.92	54	.92	49	.92	47	.92	48	.93	46	.93	42
16th	.97	46	.97	45	.99	47	.99	46	1.00	45	1.02	49	1.04	48	1.06	46	1.07	47	1.07	45	1.07	42	1.07	39	1.07	43
17th	1.06	51	1.06	50	1.06	48	1.05	49	1.05	51	1.03	52	1.03	52	1.00	53	.96	54	.96	56	.96	52	.95	53	.95	55
18th	1.07	61	1.07	60	1.07	52	1.07	48	1.07	51	1.06	51	1.05	52	1.04	54	1.03	56	1.02	57	1.02	50	1.00	50	.98	54
19th	1.05	49	1.05	51	1.05	52	1.05	50	1.03	45	1.03	45	1.05	54	1.05	52	1.05	54	1.08	55	1 10	56	1.15	56	1.17	55
20th	1.24	46	1.24	47	1.24	47	1.24	46	1.24	45	1.24	45	1.24	45	1.23	45	1.25	46	1.25	48	1.25	52	1.25	53	1.27	55
21st	1.35	55	1.35	48	1.35	50	1.35	52	1.35	45	1.35	50	1.37	55	1.40	57	1.42	52	1.42	51	1.43	52	1.45	54	1.47	54
22d	1.50	55	1.50	54	1.50	56	1.52	54	1.52	53	1.52	56	1.52	57	1.52	58	1.50	55	1.45	54	1.45	57	1.45	58	1.40	54
23d	1.23	54	1.23	52	1.23	51	1.23	50	1.20	59	1.20	60	1.18	60	1.17	57	1.15	56	1.15	55	1.15	54	1.14	56	1.14	57
24th	1.17	54	1.17	53	1.17	54	1.17	54	1.17	55	1.17	59	1.17	55	1.15	57	1.14	54	1.11	54	1.10	56	1.10	54	1.10	57
25th	.98	57	.98	58	.95	55	.95	55	.95	52	.95	55	.95	57	.95	57	.93	56	.93	54	.90	55	.90	57	.90	52
26th	.93	52	.93	54	.93	55	.95	54	.95	53	.95	55	.95	58	1.00	57	1.00	59	1.00	57	1.00	55	1.00	56	1.00	57
27th	1.00	54	1.00	55	1.00	57	1.00	53	1.03	57	1.03	55	1.03	56	1.03	54	1.02	54	1.02	56	1.02	54	1.02	55	1.04	54
28th	1.10	56	1.10	54	1.12	53	1.12	54	1.08	55	1.08	54	1.08	56	1.08	55	1.08	57	1.07	58	1.07	58	1.07	59	1.08	56
29th	1.15	57	1.15	55	1.15	56	1.15	58	1.15	55	1.16	56	1.17	56	1.18	57	1.18	56	1.18	58	1.17	59	1.17	60	1.16	60
30th	1.15	56	1.16	57	1.16	57	1.15	55	1.18	53	1.18	53	1.20	54	1.25	55	1.25	57	1.26	56	1.26	58	1.26	60	1.26	60
31st	1.17	48	1.17	47	1.17	49	1.15	48	1.11	50	1.11	47	1.11	48	1.11	49	1.10	48	1.09	51	1.08	53	1.06	52	1.05	54
Means	.994	48.8	.993	48.6	.995	48.7	.995	50.5	.995	51.2	.997	53.4	1.002	54.5	1.005	54.4	1.008	53.3	1.007	52.6	1.005	52.7	.999	52.9	.997	53.0
B. at 32°	29.939		29.939		29.941		29.936		29.934		29.930		29.932		29.935		29.941		29.942		29.940		29.933		29.931	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.97	39	.97	37	.97	38	.97	42	.97	48	.97	48	.97	48	.97	47	.97	47	.97	40	.97	40	.982	39.5	.953
2d	.92	26	.95	26	.95	36	.96	47	.97	56	.97	58	.97	57	.97	54	.97	47	.97	45	.97	40	.931	42.7	.893
3d	.70	53	.65	41	.65	40	.65	44	.62	47	.62	51	.61	54	.60	56	.60	50	.60	46	.60	41	.749	49.1	.695
4th	.28	54	.27	49	.26	47	.26	49	.25	53	.27	50	.27	46	.27	36	.27	38	.27	36	.27	35	.341	46.9	.292
5th	.50	38	.52	37	.54	44	.59	48	.60	60	.62	57	.63	51	.65	40	.64	40	.65	37	.65	36	.467	44.5	.424
6th	.71	48	.71	49	.73	52	.76	57	.76	55	.76	49	.76	43	.76	38	.75	36	.75	33	.75	34	.730	43.6	.690
7th	1.01	44	1.01	46	1.02	48	1.08	49	1.16	55	1.20	56	1.19	57	1.19	54	1.19	54	1.19	50	1.19	51	.987	53.1	.921
8th	1.30	60	1.33	57	1.33	54	1.33	57	1.33	60	1.33	61	1.33	57	1.33	53	1.33	50	1.33	47	1.33	45	1.293	54.1	1.224
9th	1.17	60	1.13	61	1.12	62	1.10	60	1.07	57	1.05	55	1.00	56	.96	56	.90	56	.90	56	.87	55	1.167	56.5	1.091
10th	.85	57	.85	60	.85	59	.83	56	.83	57	.83	58	.83	56	.83	57	.83	60	.80	58	.81	57	.842	57.7	.765
11th	.70	58	.70	56	.70	52	.70	51	.70	56	.70	60	.70	62	.70	60	.70	55	.70	51	.72	47	.726	56.9	.651
12th	.96	63	.97	61	1.00	61	1.00	64	1.00	57	1.00	56	1.00	53	1.02	55	1.02	56	1.02	54	1.02	51	.895	54.4	.827
13th	1.05	60	1.00	57	.98	61	.96	62	.95	60	.90	56	.90	54	.90	52	.90	51	.88	46	.88	52	.993	56.2	.919
14th	.85	54	.84	55	.84	55	.85	56	.87	58	.89	57	.91	57	.91	55	.91	55	.92	55	.94	55	.874	53.8	.807
15th	.94	43	.94	41	.94	40	.95	40	.95	41	.95	42	.95	41	.95	42	.95	40	.95	40	.95	35	.933	46.4	.885
16th	1.07	49	1.07	52	1.07	55	1.08	57	1.08	56	1.10	55	1.10	54	1.10	53	1.10	50	1.09	52	1.08	51	1.055	48.8	1.001
17th	.95	56	.95	54	.95	56	.95	54	.95	52	.96	56	.96	54	.97	56	.99	57	1.00	55	1.02	58	.990	53.5	.923
18th	.98	53	.98	52	.98	51	.98	50	.98	53	.98	52	.98	51	1.00	51	1.04	52	1.04	51	1.05	51	1.022	52.6	.957
19th	1.18	56	1.20	54	1.20	53	1.20	52	1.20	55	1.20	54	1.20	52	1.21	50	1.23	47	1.24	45	1.25	46	1.134	51.6	1.072
20th	1.27	57	1.27	56	1.27	55	1.27	57	1.27	54	1.28	52	1.28	52	1.30	...	1.32	...	1.32	...	1.34	...	1.265	50.8	1.205
21st	1.47	50	1.47	52	1.48	47	1.50	45	1.50	44	1.50	46	1.50	44	1.50	45	1.50	42	1.52	43	1.52	41	1.438	48.9	1.383
22d	1.40	52	1.38	55	1.37	53	1.37	52	1.37	54	1.37	52	1.36	51	1.32	53	1.30	52	1.25	55	1.23	54	1.420	54.3	1.350
23d	1.14	56	1.14	54	1.14	52	1.14	50	1.14	54	1.14	53	1.14	54	1.16	53	1.16	52	1.16	57	1.17	55	1.168	54.6	1.098
24th	1.10	58	1.10	56	1.10	55	1.10	56	1.09	55	1.08	57	1.06	56	1.06	...	1.05	...	1.03	...	1.00	...	1.111	55.6	1.039
25th	.90	56	.90	56	.90	55	.90	57	.90	55	.90	53	.92	54	.92	56	.92	57	.92	58	.92	56	.926	55.5	.854
26th	1.00	57	1.00	57	1.00	55	1.00	56	1.00	54	1.00	54	.99	55	.99	56	1.00	54	1.00	53	1.00	52	.982	55.2	.910
27th	1.05	54	1.05	56	1.05	57	1.07	55	1.07	57	1.07	56	1.07	56	1.07	55	1.07	57	1.10	56	1.10	54	1.042	55.3	.970
28th	1.08	55	1.10	57	1.10	54	1.10	54	1.10	56	1.10	54	1.10	52	1.10	53	1.10	52	1.10	53	1.10	52	1.092	54.9	1.034
29th	1.15	59	1.15	58	1.14	57	1.12	59	1.12	58	1.12	57	1.15	56	1.15	57	1.15	59	1.15	58	1.15	58	1.153	57.5	1.076
30th	1.26	57	1.25	56	1.25	53	1.25	56	1.25	56	1.24	57	1.20	...	1.20	...	1.18	...	1.18	...	1.18	...	1.215	55.4	1.142
31st	1.05	55	1.05	57	1.05	57	1.00	57	1.00	56	1.00	55	1.00	57	1.00	58	1.00	57	1.02	53	1.02	54	1.069	52.5	1.005
Means	.999	52.8	.997	52.1	.998	52.1	1.001	53.2	1 001	54.5	1.003	54.1	1.001	53.1	1.002	52.1	1.001	51.2	1.001	49.8	1.002	48.9	1.000	52.0	
B. at 32°	29.934		29.934		29.935		29.935		29.931		29.935		29.935		29.939		29.941		29.943		29.947		29.937		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR, In June, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in house on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch	°	Inch.	°
1st	.98	47	.98	48	.97	48	.95	46	.95	47	.95	46	.95	47	.95	48	.95	49	.95	49	.90	51	.90	52	.88	53
2d	.82	54	.82	52	.82	55	.82	56	.84	57	.85	57	.85	54	.85	50	.85	52	.85	54	.85	58	.85	56	.84	57
3d	1.25	54	1.25	54	1.25	53	1.25	54	...	...	...	...	...	...	...	...	.94	54	.95	53	.97	56	.97	58	.98	57
4th	1.00	62	1.00	60	1.00	62	.92	63	...	...	...	...	...	...	...	...	1.00	62	1.00	64	1.00	60	1.00	60	.93	51
5th	1.00	50	1.00	52	1.00	47	1.00	47	1.00	48	1.00	48	.98	50	.98	49	.98	47	.98	45	.97	47	.95	46	.94	56
6th	.78	50	.75	46	.75	46	.73	47	.80	54	.78	54	.80	54	.80	55	.80	54	.76	54	.73	50	.72	53	.72	53
7th	.69	(45)	.69	44	.69	46	.69	48	.68	49	.68	50	.67	52	.65	53	.62	53	.62	53	.63	60	.63	73	.56	56
8th	.65	56	.56	46	.59	52	.71	53	.70	53	.73	60	.77	68	.79	56	.80	53	.80	50	.81	54	.83	46	.83	46
9th	.85	52	.86	48	.87	50	.87	52	.87	52	.87	53	.87	53	.86	53	.86	55	.83	51	.83	54	.80	63	.80	64
10th	.60	53	.60	54	.59	52	.59	48	.60	47	.60	54	.60	57	.60	58	.61	58	.62	57	.65	54	.68	54	.68	54
11th	.70	52	.70	54	.70	55	.70	56	.70	52	.70	50	.71	53	.71	53	.65	53	.65	54	.69	50	.69	54	.70	52
12th	.68	56	.68	56	.68	54	.67	54	.66	54	.67	(54)	.67	(54)	.66	(54)	.62	54	.63	54	.64	56	.64	54	.63	58
13th	.64	56	.64	58	.64	56	.64	58	.67	54	.68	51	.68	53	.68	55	.63	54	.63	54	.64	56	.64	56	.64	54
14th	.58	56	.58	54	.58	53	.58	53	.58	54	.58	55	.58	56	.57	60	.55	...	.56	...	.57	...	.60	...	.60	...
15th	.66	60	.65	60	.65	60	.66	60	.70	56	.70	55	.70	54	.70	53	.67	56	.67	58	.70	54	.70	54	.70	56
16th	.63	56	.62	58	.61	58	.61	58	.60	56	.60	55	.60	56	.58	56	.50	58	.49	58	.50	53	.51	52	.53	54
17th	.60	56	.62	54	.63	56	.65	54	.68	49	.70	53	.70	54	.71	55	.72	56	.72	58	.76	56	.79	54	.78	56
18th	.90	56	.97	54	.99	53	.99	52	.90	56	.90	56	.90	56	.94	59	.92	57	.93	58	.94	58	.94	58	.94	58
19th	.95	56	.95	58	.95	60	.95	60	.96	58	.97	57	.97	58	.97	59	.97	58	.98	60	1.02	58	1.03	58	1.03	60
20th	.96	62	.96	64	.92	64	.90	63	.90	58	.90	59	.86	59	.84	55	.80	56	.78	56	.78	56	.77	58	.76	56
21st	.71	56	.73	58	.73	58	.85	58	.80	58	.80	58	.80	57	.79	56	.80	56	.78	56	.78	56	.90	55	.90	54
*22d	.87	58	.87	58	.83	58	.80	58	.85	63	.80	44	.85	47	.85	45	.85	42	.84	39	.86	40	.86	40	.85	37
*23d	.85	34	.83	36	.82	38	.81	38	.76	34	.77	34	.77	34	.77	34	.75	32	.75	34	.75	34	.75	34	.75	36
24th	.75	56	.78	56	.77	56	.77	56	.73	65	.74	65	.76	66	.85	58	.77	56	.77	59	.77	60	.76	58	.75	56
25th	.80	57	.80	56	.80	56	.80	56	.85	60	.85	61	.85	61	.87	58	.86	57	.88	58	.88	59	.88	59	.87	58
26th	.75	58	.75	64	.75	60	.74	60	.72	58	.72	56	.72	57	.72	56	.70	58	.70	57	.70	57	.70	54	.72	58
27th	.76	60	.76	58	.76	57	.76	55	.78	56	.78	54	.78	55	.78	54	.78	54	.78	54	.78	56	.79	53	.80	52
28th	.57	58	.57	56	.57	56	.57	55	.56	55	.56	55	.56	56	.57	57	.59	58	.59	58	.62	56	.62	54	.63	54
29th	.73	55	.73	56	.74	55	.74	57	.75	42	.75	42	.76	44	.76	46	.78	48	.78	48	.78	52	.78	52	.80	51
30th	.84	58	.84	58	.84	52	.85	51	.85	58	.84	58	.85	58	.85	58	.85	55	.85	55	.87	54	.89	53	.90	50
Means	.785	54.6	.785	54.3	.783	54.2	.786	54.2	.786	54.0	.785	53.7	.787	54.6	.788	54.0	.772	53.8	.771	53.9	.779	54.2	.786	54.4	.781	53.9
B. at 32°	29.716		29.717		29.715		29.718		29.720		29.718		29.719		29.721		29.705		29.704		29.712		29.718		29.714	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.87	55	.86	57	.86	56	.85	55	.85	56	.83	57	.82	57	.84	56	.84	58	.82	56	.82	54	.897	52.0	.834
2d	.84	55	.84	54	.84	52	.83	54	.84	56	.85	56	.85	55	.88	54	.88	53	.90	54	.90	56	.848	54.6	.778
3d	.98	56	.99	55	.99	56	1.00	57	1.00	57	1.00	55	1.00	53	1.00	52	1.00	53	1.00	54	1.00	53	1.047	54.6	.977
4th	.95	50	.94	50	.95	53	1.00	69	1.00	69	1.00	64	1.00	64	1.00	63	1.00	64	1.00	65	1.00	65	.982	61.3	.894
5th	.93	50	.92	51	.91	53	.90	52	.91	52	.88	...	.87	...	.87	...	.87	...	.87	...	.88	...	.941	49.8	.882
6th	.72	45	.73	50	.73	50	.73	52	.73	53	.73	...	.73	...	.74	...	.78	...	.78	...	.75	...	.753	50.6	.693
7th	.59	52	.60	59	.55	57	.55	57	.56	56	.66	...	.65	...	.63	...	.64	...	.65	...	.65	...	.634	54.1	.566
8th	.87	53	.87	52	.87	53	.87	53	.87	53	.87	...	.86	...	.81	...	.86	...	.80	...	.78	...	.787	53.0	.722
9th	.75	64	.74	56	.74	55	.74	54	.73	53	.85	...	.83	...	.81	...	.82	...	.82	...	.85	...	.822	54.2	.754
10th	.66	54	.66	52	.67	52	.67	52	.67	52	.72	56	.73	57	.64	52	.65	52	.64	52	.65	52	.641	53.5	.575
11th	.70	54	.70	53	.70	52	.69	56	.69	55	.67	56	.68	55	.67	56	.67	54	.65	56	.64	54	.686	53.7	.620
12th	.62	52	.63	55	.63	56	.63	57	.63	54	.61	57	.62	56	.64	54	.65	48	.64	48	.64	54	.644	54.3	.576
13th	.64	54	.64	54	.64	54	.64	53	.64	53	.60	54	.61	54	.62	54	.62	56	.59	56	.59	54	.637	54.6	.568
14th	.60	...	.60	...	.60	...	.61	...	.60	...	.60	...	.60	...	.61	...	.61	...	.61	...	.62	...	.590	58.4	.511
15th	.70	54	.73	56	.73	54	.73	54	.73	54	.66	56	.64	58	.65	58	.64	56	.65	58	.64	58	.682	56.3	.608
16th	.53	54	.53	56	.53	56	.53	56	.53	56	.53	58	.52	56	.54	56	.54	56	.56	56	.56	56	.553	56.0	.480
17th	.79	58	.79	56	.79	54	.79	54	.79	54	.79	56	.79	56	.80	58	.78	56	.79	56	.79	56	.740	55.2	.669
18th	.94	56	.94	58	.95	57	.94	56	.94	56	.94	46	.94	44	.99	45	.94	59	.94	60	.94	60	.940	55.3	.869
19th	1.03	60	1.02	60	1.01	60	1.00	60	1.00	60	1.00	58	.97	58	.96	58	.97	58	1.02	58	1.02	58	.987	58.7	.908
20th	.75	54	.70	54	.67	53	.65	52	.65	48	.65	58	.66	53	.66	55	.65	59	.67	59	.70	59	.772	57.1	.696
21st	.90	53	.90	52	.90	48	.90	46	.90	54	.90	56	.92	54	.93	51	.94	50	.94	49	.93	45	.851	53.9	.793
*22d	.85	54	.84	42	.84	42	.83	41	.83	40	.89	34	.87	36	.86	38	.86	34	.88	32	.88	32	.850	43.9	.809
*23d	.75	45	.75	44	.75	44	.75	46	.75	53	.74	57	.74	57	.74	56	.74	54	.76	54	.78	52	.766	42.2	.730
24th	.75	54	.75	52	.75	52	.76	50	.77	54	.83	56	.83	56	.84	56	.84	55	.83	56	.82	56	.781	56.8	.707
25th	.87	55	.87	55	.87	56	.88	57	.86	57	.83	56	.84	53	.86	54	.83	55	.86	54	.86	55	.851	56.8	.777
26th	.71	56	.71	54	.71	54	.71	53	.71	52	.70	58	.69	58	.70	58	.70	58	.69	58	.69	58	.713	57.1	.637
27th	(.80)	(52)	.80	50	.79	53	.75	54	.73	54	.70	58	.70	58	.69	56	.67	56	.66	56	.65	58	.751	55.1	.681
28th	.64	53	.65	52	.65	52	.65	52	.65	54	.70	55	.70	56	.70	56	.72	56	.72	54	.72	53	.628	55.0	.558
29th	.80	50	.80	52	.80	52	.80	54	.80	53	.80	55	.80	57	.80	57	.80	56	.80	57	.80	57	.778	52.0	.716
30th	.91	53	.92	52	.92	52	.93	52	.94	52	.94	48	.94	47	.94	46	.94	45	.94	43	.94	43	.891	52.1	.829
Means	.781	53.8	.781	53.4	.778	53.3	.777	53.9	.777	54.3	.782	54.9	.780	54.4	.781	54.1	.782	54.1	.783	54.0	.783	53.8	.781	54.1	
B. at 32°	29.714		29.714		29.711		29.709		29.708		29.712		29.710		29.712		29.713		29.715		29.716		29.714		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,

In July, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.94	43	.94	43	.94	44	.94	42	.94	44	.94	46	.94	46	.95	45	.95	48	.97	48	.97	48	.97	50	.94	52
2d	.94	43	.94	44	.94	42	.95	44	.93	48	.93	48	.91	49	.90	49	.90	50	.90	50	.90	51	.90	52	.90	53
3d	.89	43	.86	42	.85	43	.84	42	.84	43	.85	44	.85	46	.84	46	.83	46	.83	48	.82	49	.82	51	.84	52
4th	.90	47	.90	48	.89	47	.88	48	.90	53	.90	55	.90	48	.90	56	.90	56	.90	56	.90	55	.90	56	.91	57
5th	.83	52	.82	52	.81	47	.80	47	.80	46	.80	46	.80	49	.80	52	.78	50	.78	51	.78	51	.78	51	.78	60
6th	.77	52	.78	51	.78	57	.78	57	.79	48	.79	49	.79	48	.79	49	.78	49	.78	48	.78	47	.77	46	.77	45
7th	.81	40	.82	41	.82	41	.82	42	.82	40	.82	41	.82	44	.82	45	.81	45	.81	44	.81	44	.81	44	.80	45
8th	.83	42	.83	47	.83	45	.83	41	.83	41	.83	42	.84	43	.84	44	.84	44	.84	44	.83	45	.83	45	.83	45
9th	.78	39	.78	40	.78	38	.79	38	.79	40	.78	40	.78	42	.78	43	.78	44	.78	44	.78	45	.78	49	.77	52
10th	.71	41	.71	41	.70	41	.70	40	.70	42	.70	44	.70	45	.70	46	.70	47	.68	45	.68	49	.67	49	.65	50
11th	.66	42	.65	42	.68	42	.65	42	.65	42	.64	44	.64	45	.64	47	.60	49	.60	49	.60	50	.60	50	.56	57
12th	.64	46	.64	47	.64	46	.64	46	.64	47	.64	48	.64	47	.65	49	.65	47	.65	47	.65	45	.65	43	.65	46
13th	.65	42	.65	43	.65	43	.67	44	.67	45	.67	45	.67	46	.70	48	.70	47	.71	47	.73	45	.73	46	.75	47
14th	.81	40	.81	41	.78	40	.78	41	.78	40	.78	41	.78	43	.78	44	.79	44	.80	47	.79	49	.79	51	.79	51
15th	.66	43	.66	44	.65	44	.65	44	.62	43	.63	41	.63	43	.63	44	.63	45	.63	42	.63	42	.63	43	.64	41
16th	...	...	...	...	...	...	...	...	.50	40	.50	42	.52	41	.52	42	.52	42	.53	42	.53	43	.53	42	.54	42
17th	...	...	...	...	...	...	...	...	.72	46	.73	45	.75	44	.75	45	.76	46	.76	46	.77	48	.77	49	.77	50
18th	...	...	...	...	...	...	...	...	.75	45	.75	43	.75	44	.78	42	.78	42	.78	41	.77	41	.77	41	.77	42
19th	...	...	...	...	...	...	...	...	.80	42	.80	42	.81	44	.82	45	.82	46	.82	47	.85	49	.90	50	.90	50
20th	.98	45	.99	43	1.00	40	1.00	41	1.00	40	1.00	41	1.00	43	1.00	44	1.01	46	1.01	48	1.02	48	1.03	50	1.02	52
21st	.98	42	.98	42	.98	41	.98	41	.95	41	.95	42	.94	43	.94	43	.90	44	.95	44	.95	43	.95	43	.81	44
22d	.79	43	.78	43	.78	44	.79	44	.79	43	.79	44	.81	42	.81	43	.81	45	.81	47	.81	49	.81	54	.81	55
23d	.80	46	.79	45	.79	43	.78	42	.78	45	.78	46	.78	47	.78	48	.78	50	.78	53	.77	53	.77	54	.79	57
24th	.87	44	.86	43	.86	50	.86	48	.86	50	.86	52	.87	42	.87	42	.87	46	.87	48	.89	50	.89	50	.89	49
25th	.80	45	.80	45	.78	44	.78	44	.75	45	.75	45	.75	48	.75	48	.76	49	.77	50	.79	51	.78	52	.78	53
26th	.85	43	.85	42	.85	41	.84	42	.82	40	.82	40	.82	42	.83	42	.83	40	.85	42	.90	43	.90	43	.90	44
27th	.90	42	.92	45	.92	41	.93	40	.92	40	.91	39	.91	38	.90	37	.90	46	.90	46	.88	47	.84	48	.82	49
28th	.54	42	.52	41	.50	42	.46	42	.43	41	.45	42	.48	42	.50	43	.53	44	.54	45	.55	45	.55	45	.58	46
29th	.90	45	.90	43	.90	42	.90	41	.90	38	.90	39	.90	40	.90	47	.90	47	.90	47	.90	47	.90	47	.87	46
30th	.67	38	.65	36	.64	36	.63	34	.63	36	.63	38	.65	40	.65	42	.64	44	.62	49	.61	50	.62	52	.62	54
*31st	.67	37	.66	36	.65	35	.63	36	...	...	...	...	...	...	...	...	.69	42	.70	44	.75	49	.77	52	.77	56
Means	.789	43.1	.786	43.3	.781	42.9	.778	42.8	.772	42.9	.773	43.6	.778	44.0	.781	45.2	.779	46.1	.782	46.7	.787	47.5	.790	48.3	.781	49.7
B. at 32°	29.750		29.746		29.743		29.741		29.734		29.733		29.737		29.736		29.733		29.734		29.739		29.737		29.725	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32.°
	Inch.	°	Inch.	°	Inch	°	Inch	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.94	54	.95	56	.95	59	.95	46	.95	47	.96	46	.96	46	.94	44	.94	45	.94	44	.94	44	.948	47.1	.898
2d	.90	51	.90	49	.90	52	.90	46	.90	46	.90	47	.90	46	.91	47	.91	45	.90	46	.90	46	.912	47.7	.860
3d	.84	52	.84	59	.84	62	.84	57	.84	56	.85	58	.85	57	.87	56	.87	52	.89	55	.90	49	.850	50.3	.792
4th	.91	60	.93	64	.93	59	.92	57	.91	56	.91	57	.91	57	.91	59	.89	59	.85	62	.83	60	.899	55.5	.827
5th	.76	63	.76	65	.77	67	.78	58	.78	61	.78	62	.78	63	.77	58	.77	60	.77	58	.77	54	.785	55.1	.714
6th	.80	46	.80	46	.80	45	.80	43	.80	43	.80	42	.80	42	.80	42	.80	40	.80	48	.80	40	.789	46.8	.740
7th	.80	44	.80	44	.80	43	.80	42	.80	44	.81	44	.81	42	.81	42	.83	41	.83	45	.83	48	.813	43.1	.774
8th	.82	44	.82	44	.82	44	.82	43	.81	44	.81	44	.81	44	.80	44	.80	41	.80	40	.80	39	.822	43.3	.783
9th	.77	51	.77	51	.77	50	.77	51	.77	51	.76	51	.76	52	.75	52	.75	50	.74	46	.71	44	.770	46.0	.724
10th	.65	51	.65	56	.64	60	.64	57	.64	57	.63	55	.62	53	.61	51	.61	52	.61	49	.56	45	.661	48.6	.608
11th	.56	60	.59	62	.64	56	.64	57	.64	58	.64	58	.64	56	.65	49	.65	48	.65	45	.65	44	.630	49.7	.573
12th	.65	46	.65	46	.65	47	.65	46	.65	45	.65	45	.65	44	.65	43	.68	41	.65	43	.65	43	.648	45.5	.603
13th	.75	49	.75	50	.75	50	...	...	...	...	.77	45	.77	45	...	...	...	...	...	...	...	...	.725	45.5	.680
14th	.79	52	.79	55	.79	55	.78	40	.79	54	.79	53	.78	57	.73	47	.71	44	.69	43	.67	43	.774	46.5	.726
15th	.64	41	.64	40	.64	40	.65	42	.65	41	.65	43	.65	42	.65	42	.65	42	.65	41	.65	41	.642	42.2	.605
16th	.54	41	.55	42	.63	44	.60	42	.60	43	.63	42	.65	41	.66	41	.67	42	.68	42	.69	42	.580	41.6	.545
17th	.77	49	.77	46	.77	45	.77	45	.77	45	.77	44	.76	43	...	...	...	...	...	...	...	...	.751	45.4	.706
18th	.77	42	.77	41	.79	42	.81	43	.82	45	.83	44	.84	44	.84	43	.84	43	.84	42	.83	42	.787	43.0	.749
19th	.90	47	.92	51	.93	50	.94	49	.94	48	.94	47	.93	47	.94	45	.96	44	.94	43	.92	43	.877	45.7	.831
20th	1.03	53	1.02	54	1.02	55	1.02	56	1.03	56	1.00	55	1.00	55	1.00	54	1.00	53	1.00	51	1.00	51	1.007	48.9	.953
21st	.81	44	.82	44	.82	45	.82	48	.82	47	.82	49	.82	50	.82	45	.82	46	.82	47	.80	47	.885	44.4	.842
22d	.81	56	.81	55	.80	53	.80	52	.80	53	.80	53	.80	52	.90	44	.95	44	.95	43	.95	43	.823	47.7	.773
23d	.79	57	.78	56	.77	55	.77	55	.75	53	.75	52	.75	51	.73	50	.73	52	.72	51	.73	51	.768	50.5	.709
24th	.85	48	.85	48	.85	48	.80	47	.80	49	.80	49	.80	46	.76	44	.78	44	.78	43	.78	42	.840	46.8	.791
25th	.78	53	.78	53	.78	61	.78	52	.77	50	.77	49	.77	47	.78	47	.75	44	.73	44	.72	43	.769	48.4	.716
26th	.90	43	.90	44	.90	44	.92	49	.92	49	.92	47	.92	46	.93	44	.93	44	.93	44	.93	44	.882	43.4	.842
27th	.80	52	.80	53	.80	55	.80	49	.76	48	.73	47	.69	47	.65	45	.60	44	.58	43	.56	44	.809	45.2	.764
28th	.64	47	.66	46	.70	47	.72	47	.75	46	.78	45	.81	44	.90	44	.90	43	.90	43	.90	42	.637	43.9	.596
29th	.86	45	.86	45	.86	45	.82	44	.80	44	.78	44	.75	44	.72	44	.72	41	.72	43	.69	39	.844	43.6	.804
30th	.62	60	.63	64	.63	60	.63	57	.63	52	.63	49	.63	49	.63	49	.63	46	.63	41	.63	41	.632	46.5	.584
*31st	.73	55	.75	58	.77	57	.78	49	.77	49	.78	47	.78	47	.77	46	.76	45	.75	43	.75	40	.721	44.9	.677
Means	.780	50.2	.784	51.2	.791	51.5	.790	48.9	.788	49.2	.788	48.8	.787	48.4	.788	46.7	.788	45.9	.784	45.7	.777	44.5	.783	46.5	
B at 32°	29.723		29.724		29.730		29.736		29.733		29.735		29.734		29.740		29.742		29.739		29.734		29.736		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR, In August, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.75	42	.75	42	.74	42	.73	42	.74	41	.72	40	.70	45	.70	46	.67	48	.65	52	.63	50	.63	51	.64	52
2d	.54	37	.54	38	.54	37	.54	38	.54	37	.56	39	.56	42	.57	43	.58	43	.58	43	.60	45	.60	47	.60	45
3d	.60	40	.62	41	.62	42	.65	43	.66	42	.68	42	.69	42	.69	40	.70	39	.70	40	.71	41	.71	42	.75	42
4th	.80	39	.80	39	.80	38	.80	37	.80	37	.80	38	.80	40	.82	43	.82	45	.83	44	.83	44	.85	43	.86	44
5th	.90	40	.90	41	.90	39	.90	38	.90	39	.90	40	.90	41	.90	42	.90	44	.90	46	.90	49	.90	51	.90	50
6th	.85	41	.85	40	.83	39	.83	37	.83	38	.83	37	.83	41	.83	42	.83	45	.82	47	.82	52	.82	52	.82	54
7th	.81	39	.81	37	.80	35	.80	33	.80	36	.80	38	.80	40	.80	42	.80	47	.80	49	.80	51	.80	53	.80	57
8th	.85	40	.85	40	.86	41	.87	40	.87	40	.88	42	.89	44	.91	45	.92	47	.95	49	.95	49	.96	49	.96	47
9th	1.08	45	1.08	43	1.08	41	1.08	41	1.08	39	1.08	40	1.08	41	1.08	43	1.09	44	1.09	45	1.09	45	1.09	45	1.07	43
10th	.98	39	.97	40	.96	41	.96	40	.95	41	.95	40	.95	39	.95	40	.95	41	.95	44	.95	45	.95	47	.94	48
11th	.93	41	.95	40	.95	38	.95	38	.94	39	.94	37	.94	38	.94	39	.94	39	.94	40	.94	46	.94	45	.92	43
12th	.82	40	.82	39	.82	37	.82	37	.82	36	.82	37	.82	38	.81	38	.80	39	.79	40	.78	41	.78	42	.77	44
13th	.77	38	.76	41	.75	36	.74	36	.74	36	.73	36	.73	36	.70	35	.66	35	.65	35	.64	36	.63	36	.62	36
14th	.38	36	.37	34	.35	34	.34	35	.33	35	.32	36	.31	35	.31	35	.31	35	.30	35	.30	36	.30	36	.30	35
15th	.45	34	.46	33	.50	33	.51	33	.64	34	.65	35	.66	36	.67	37	.68	38	.69	39	.71	38	.72	38	.72	39
16th	.76	28	.76	29	.76	28	.76	28	.76	29	.76	31	.76	35	.76	36	.75	38	.75	40	.75	41	.74	43	.74	50
17th	.65	33	.65	32	.64	33	.64	34	.65	36	.66	36	.67	37	.67	36	.67	37	.70	37	.72	39	.70	40	.70	41
18th	.74	34	.74	32	.74	32	.74	31	.74	35	.74	36	.74	38	.74	38	.74	39	.73	38	.73	39	.73	40	.72	41
19th	.70	39	.71	31	.70	32	.70	32	.69	32	.69	32	.69	32	.69	33	.69	32	.69	34	.68	36	.68	37	.67	35
20th	.63	36	.63	37	.63	36	.63	36	.64	34	.64	35	.64	35	.64	35	.64	35	.65	36	.65	35	.65	35	.65	36
21st	.70	32	.70	32	.70	33	.70	32	.70	34	.70	33	.70	34	.70	36	.70	36	.70	37	.70	36	.70	36	.70	36
22d	.72	30	.72	29	.72	25	.72	26	.74	27	.75	28	.75	30	.75	31	.76	32	.76	32	.78	32	.75	34	.77	32
23d	.65	30	.65	28	.64	27	.64	25	.63	26	.60	24	.59	25	.58	24	.56	30	.55	31	.57	34	.57	38	.57	39
24th	.61	28	.61	27	.61	28	.60	28	.73	24	.73	25	.73	28	.73	37	.74	36	.74	37	.74	35	.74	38	.74	36
25th	.74	29	.75	29	.75	30	.75	31	.75	28	.75	29	.76	30	.76	31	.76	32	.75	32	.75	33	.74	34	.74	33
26th	.60	30	.60	29	.60	29	.60	28	.59	26	.58	25	.57	24	.57	27	.65	27	.65	30	.65	30	.65	30	.66	30
*27th	...	...	...	...	...	...	...	...	.65	30	.65	31	.65	30	.65	30	.83	...	.84	...	.84	...	.85	...	.86	...
28th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.68	33	.68	34	.68	35	.67	33	.67	36
29th	.70	25	.71	29	.71	29	.71	30	.71	29	.71	30	.72	32	.72	33	.71	34	.71	33	.71	32	.71	32	.70	33
30th	.52	33	.50	33	.47	32	.44	32	.42	32	.41	31	.39	31	.34	30	.30	31	.29	31	.29	32	.29	33	...	...
31st	.30	30	.32	28	.33	27	.34	28	.36	28	.37	30	.38	32	.39	31	.39	32	.39	33	.38	33	.38	33	.38	33
Means	.705	35.2	.706	34.6	.704	34.1	.704	33.9	.712	34.0	.712	34.4	.712	35.6	.711	36.5	.717	37.5	.717	38.5	.718	39.4	.717	40.1	.717	40.5
B. at 32°	29.687		29.690		29.689		29.689		29.697		29.696		29.694		29.690		29.694		29.690		29.689		29.687		29.685	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.64	53	.63	52	.61	51	.60	50	.59	48	.57	47	.56	47	.55	45	.55	44	.55	42	.55	39	.644	46.3	.597
2d	.60	45	.60	45	.60	45	.61	41	.60	52	.60	49	.60	45	.61	49	.61	48	.61	45	.61	43	.583	43.4	.544
3d	.78	42	.80	41	.80	40	.80	41	.80	42	.80	42	.80	41	.80	42	.80	41	.80	40	.80	38	.732	41.1	.698
4th	.87	43	.88	42	.89	47	.88	45	.88	45	.89	45	.89	43	.90	41	.90	41	.90	40	.90	40	.850	41.7	.815
5th	.90	51	.90	(50)	.90	(50)	.90	50	.90	48	.90	48	.90	47	.90	47	.87	45	.85	44	.85	43	.895	45.1	.851
6th	.82	59	.82	60	.82	54	.83	55	.83	54	.83	52	.82	50	.81	50	.81	49	.81	45	.80	46	.825	47.4	.775
7th	.82	54	.83	59	.85	62	.84	54	.84	54	.84	53	.85	53	.85	51	.85	47	.85	39	.85	41	.820	46.8	.772
8th	.96	48	.96	48	.96	49	.97	44	.97	50	.98	51	1.01	51	1.02	51	1.02	51	1.06	52	1.07	43	.946	46.3	.899
9th	1.06	42	1.03	42	1.04	45	1.02	46	1.02	45	1.00	44	.98	44	.98	43	.98	42	.98	41	.98	41	1.047	42.9	1.009
10th	.94	47	.94	49	.94	52	.94	50	.95	50	.95	53	.95	54	.98	37	.95	39	.95	40	.95	41	.952	44.0	.910
11th	.92	43	.91	45	.91	44	.90	43	.90	40	.88	41	.87	42	.84	42	.84	43	.84	42	.84	42	.911	41.2	.877
12th	.77	47	.77	50	.77	51	.77	49	.77	48	.77	47	.77	46	.77	44	.78	43	.77	42	.77	41	.790	42.3	.753
13th	.58	36	.57	36	.54	36	.54	36	.54	35	.51	35	.49	34	.47	34	.45	34	.41	35	.39	34	.609	35.7	.590
14th	.30	36	.30	36	.31	36	.33	35	.34	35	.35	34	.37	36	.38	34	.40	35	.40	35	.40	35	.337	35.2	.319
15th	.72	39	.73	39	.74	39	.75	39	.76	38	.77	37	.77	35	.79	35	.79	34	.79	34	.79	34	.686	36.2	.666
16th	.73	49	.72	48	.72	49	.70	51	.68	48	.67	46	.67	45	.67	41	.67	39	.65	34	.65	31	.723	39.0	.695
17th	.70	41	.70	43	.70	39	.73	34	.73	33	.73	32	.73	32	.73	35	.74	36	.74	34	.74	32	.695	35.9	.675
18th	.72	44	.72	48	.72	46	.72	45	.72	45	.73	43	.72	43	.71	43	.70	37	.70	35	.70	33	.726	39.0	.698
19th	.65	34	.64	34	.64	34	.64	38	.63	39	.62	38	.62	38	.62	37	.62	37	.63	36	.64	32	.664	34.7	.647
20th	.66	37	.65	38	.67	37	.68	38	.69	37	.70	35	.70	32	.70	30	.70	31	.70	31	.70	31	.661	34.9	.643
21st	.70	35	.70	35	.71	36	.74	36	.73	35	.73	33	.72	33	.72	33	.72	33	.71	33	.70	31	.707	34.2	.692
22d	.76	34	.75	34	.75	34	.75	33	.75	32	.75	32	.75	32	.72	31	.70	31	.67	30	.65	29	.737	30.8	.730
23d	.57	40	.56	41	.56	40	(.57)	(41)	.58	42	.62	34	.63	25	.65	25	.65	25	.65	26	.65	26	.604	31.1	.597
24th	.74	37	.74	38	.74	37	.73	36	.74	36	.74	34	.75	34	.75	33	.76	32	.79	32	.74	32	.720	32.8	.709
25th	.74	33	.74	35	.74	34	.74	34	.70	34	.68	32	.65	32	.65	32	.65	33	.64	32	.60	32	.720	31.8	.712
26th	.67	32	.65	31	.64	31	.62	33	.62	34	.61	35	...	...	...	...	...	...	...	...	...	...	.621	30.1	.617
*27th	.86	...	.85	...	.85	...	.86	...	.86	...	.86	...	.84	...	.84	...	.86	...	.86	...	.86	...	.783	30.8	.777
28th	.67	37	.68	35	.68	35	.67	36	.67	31	.66	34	.66	34	.67	35	.67	37	.68	38	.66	36	.675	34.2	.660
29th	.70	34	.70	34	.70	34	.70	35	.70	34	.70	34	.69	34	.68	33	.68	33	.67	32	.65	32	.700	32.1	.691
30th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.23	34	.25	33	.30	32	.30	32	.323	32.5	.313
31st	.40	34	.42	34	.43	33	.45	32	...	...	...	...	...	...	.50	26	.50	24	.50	24	.50	23	.410	29.8	.407
Means	.717	41.0	.715	41.5	.715	41.5	.717	40.8	.716	40.6	.715	39.8	.713	39.0	.713	38.0	.713	37.5	.713	36.4	.707	35.4	.713	37.7	
B. at 32°	29.684		29.681		29.681		29.685		29.684		29.685		29.685		29.688		29.690		29.692		29.689		29.689		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,
In September, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.
Mercurial Barometer on deck. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.51	23	.51	20	.51	20	.51	20	.53	20	.53	21	.52	20	.51	27	.51	27	.51	32	.51	34	.51	25	.51	22
2d	...	...	...	...	.34	20	.34	20	.34	22	.33	23	.33	25	.33	25	.33	25	.33	26	.33	27	.33	28	.33	28
3d	.33	18	.34	19	.34	20	.34	18	.34	18	.34	19	.34	19	.34	20	.34	21	.39	21	.43	23	.47	23	.48	19
*4th	.53	10	.56	8	.56	9	.56	9	.57	9	.59	13	1.02	17	1.04	20	1.05	23	1.06	24	1.09	30	1.12	32	1.15	28
5th	1.16	9	1.16	10	1.16	9	1.16	9	1.12	9	1.11	10	1.09	12	1.07	12	1.06	14	1.06	19	1.05	20	1.05	22	1.01	20
6th	.91	10	.92	11	.93	11	.92	11	.92	12	.92	13	.92	19	.92	21	.93	22	.92	23	.93	23	.94	29	.95	23
7th	.94	14	.94	13	.93	12	.92	12	.91	12	.90	12	.89	12	.88	12	.88	13	.88	14	.86	19	.85	21	.83	21
8th	.84	10	.86	10	.86	11	.87	11	.88	11	.88	12	.88	14	.87	14	.87	19	.86	18	.86	17	.85	16	.85	17
9th	.92	10	.92	10	.92	11	.92	11	.93	(12)	.94	(13)	.94	(14)	.94	(15)	.94	16	.94	17	.95	17	.95	18	.95	19
*10th	.75	13	.77	12	.76	12	.75	12	.77	12	.77	14	.77	15	.77	16	.80	23	.80	26	.80	25	.78	25	.75	27
*11th	...	...	...	...	.75	10	.74	8	.75	9	.75	9	.72	11	.72	12	.70	14	.70	15	.74	18	.75	23	.76	22
12th	.86	46	.87	46	.88	45	.88	43	.89	41	.89	41	.90	42	.90	45	.90	49	.90	49	.92	47	.95	45	.97	41
13th	.92	34	.92	34	.92	33	.92	33	.90	33	.90	37	.90	35	.90	47	.90	45	.90	45	.90	46	.90	54	.90	35
*14th	.75	42	.74	39	.72	37	.70	38	.70	38	.70	40	.69	48	.68	52	.67	49	.64	45	.60	41	.60	42	.57	42
15th	.48	47	.47	45	.45	44	.45	42	.44	43	.44	45	...	...	...	...	.43	48	.43	49	.43	49	.43	43	.43	40
16th	.55	56	.53	51	.45	47	.46	46	.45	45	.47	45	.46	42	.46	44	.63	64	.70	66	.74	64	.78	60	.80	50
17th	.62	49	.62	49	.62	50	.64	48	.65	46	.65	45	.65	45	.65	58	.69	57	.72	57	.86	57	.86	56	.85	56
18th	.68	56	.69	54	.85	61	.80	60	.78	54	.78	51	.78	48	.77	46	.75	43	.80	42	.80	56	.80	58	.80	49
19th	.85	50	.85	47	.86	46	.86	45	.86	42	.85	41	.84	45	.82	58	.75	56	.75	54	.75	56	.75	54	.75	58
20th	.73	54	.73	48	.72	46	.73	45	.75	44	.75	43	.80	59	.80	64	.80	66	.80	62	.82	56	...	...	...	...
21st	.85	53	.84	54	.83	54	.81	55	.80	56	.80	55	.78	56	.75	64	.74	67	.72	68	.70	66	.63	66	.60	59
22d	.25	55	.22	48	.21	47	.19	48	.17	50	.13	51	.10	56	.10	64	.10	58	.10	50	.10	50	.10	67	.12	69
23d	.33	53	.33	55	.34	56	.37	53	.37	53	.37	50	.37	50	.37	53	.37	54	.37	53	.35	54	.31	49	.31	57
24th	.20	51	.20	49	.20	48	.20	48	.20	48	.20	52	.20	58	.20	64	.25	79	.27	68	.27	69	.31	67	.28	67
25th	.22	53	.22	54	.21	56	.20	56	.20	55	.20	57	.20	59	.20	64	.29	65	.18	61	.18	62	.18	63	.19	64
26th	.35	59	.37	57	.40	55	.40	53	.42	54	.45	55	.49	63	.53	65	.54	64	.54	65	.56	65	.55	65	.53	55
27th	.70	56	.73	56	.75	56	.77	55	.80	55	.80	54	.80	56	.83	63	.84	68	.86	62	.86	62	.86	60	.86	60
28th	.83	50	.83	52	.83	52	.83	54	.83	48	.83	47	.85	61	.85	64	.85	60	.83	57	.79	55	.75	54	.71	44
29th	.69	64	.69	57	.69	56	.69	56	.70	56	.70	53	.75	71	.75	73	.71	69	.64	61	.69	63	.72	65	.74	64
*30th	.85	48	.85	50	.83	44	.83	42	.83	42	.84	43	.84	50	.86	53	.90	54	.90	52	.90	65	.90	55	.89	55
Means	.657	37.5	.659	36.3	.661	35.9	.659	35.4	.660	35.0	.660	35.5	.675	38.9	.675	42.7	.684	44.3	.683	43.4	.692	44.5	.694	44.6	.690	42.1
B. at 32°	29.634		29.638		29.641		29.641		29.643		29.642		29.647		29.638		29.641		29.643		29.647		29.651		29.654	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch
1st	.51	23	.51	25	.50	25	.45	25	.45	26	.45	27	.45	26	.43	26	.42	24	.40	23	.40	23	.485	24.3	.495
2d	.33	26	.33	24	.33	23	.33	22	.33	23	.33	24	.33	24	.33	23	.33	23	.33	22	.33	21	.335	23.6	.348
3d	.49	20	.49	19	.49	21	.49	21	.49	20	.49	20	.49	19	.50	17	.50	17	.52	11	.53	11	.429	18.9	.454
*4th	1.17	29	1.18	27	1.21	27	1.21	26	1.22	22	1.22	22	1.23	22	1.20	18	1.20	15	1.20	11	1.20	13	1.006	19.3	1.031
5th	1.00	20	.99	15	.97	13	.94	12	.94	12	.93	12	.91	11	.90	14	.90	13	.90	13	.90	12	1.023	13.4	1.063
6th	.95	22	.95	22	.95	22	.96	20	.96	21	.96	23	.97	24	.97	22	.96	20	.96	17	.95	14	.940	19.0	.966
7th	.80	22	.78	18	.77	17	...	...	...	...	...	...	...	...	.75	10	.75	10	.75	9	.75	10	.834	14.0	.872
8th	.85	16	.85	17	.85	15	.85	15	.85	14	.85	13	.87	13	.90	16	.90	14	.90	11	.90	11	.867	14.0	.905
9th	.95	20	.95	20	.95	20	.94	20	.94	20	.94	19	.92	19	.85	17	.85	17	.87	16	.87	14	.925	16.0	.959
*10th	.75	26	.75	25	.76	24	.75	20	.74	(18)	.73	(16)	.72	(14)	.70	12	.70	11	...	...	...	...	.753	17.4	.783
*11th	.76	22	.77	21	.79	25	.79	13	.79	10	.81	39	.84	44	.88	49	.88	51	.86	58	.86	57	.774	23.3	.787
12th	.95	42	.81	39	.80	41	.80	46	.80	49	.83	45	.84	48	.90	46	.90	44	.91	43	.92	42	.882	44.4	.839
13th	.90	38	.90	40	.90	44	.90	46	.90	46	.90	45	.87	46	.85	48	.83	46	.79	52	.79	49	.888	42.1	.851
*14th	.57	41	.52	48	.52	50	.52	50	.52	51	.56	55	.56	56	.54	58	.54	57	.54	55	.54	50	.612	46.8	.564
15th	.43	40	.43	37	.43	38	.43	39	.43	48	.42	47	.43	47	.45	58	.45	60	.45	59	.46	56	.440	46.5	.393
16th	.80	47	.82	62	.87	67	.86	74	.86	75	.81	72	.72	69	.65	64	.65	64	.62	62	.62	57	.657	58.0	.579
17th	.85	56	.85	57	.85	56	.85	58	.87	60	.87	64	.86	62	.86	63	.86	63	.82	62	.82	63	.768	55.7	.696
18th	.80	47	.80	46	.83	47	.86	58	.86	64	.86	58	.85	58	.85	58	.85	58	.85	56	.85	51	.806	53.3	.740
19th	.75	60	.75	62	.75	64	.75	65	.75	62	.75	61	.75	57	.75	55	.75	57	.74	60	.74	56	.782	54.6	.714
20th	...	...	.85	47	.86	56	.87	69	.90	69	.90	67	.90	60	.90	56	.88	58	.86	57	.85	54	.821	55.5	.749
21st	.59	55	.55	54	.55	65	.55	68	.59	68	.55	57	.51	55	.40	52	.40	50	.37	56	.28	48	.633	58.4	.554
22d	.14	60	.15	58	.16	54	.17	55	.19	57	.28	68	.30	65	.32	55	.32	53	.30	57	.30	61	.188	56.5	.115
23d	.31	63	.33	56	.32	57	.32	61	.30	74	.30	68	.30	63	...	...	...	...	...	...	...	...	.323	56.7	.250
24th	.28	67	.29	63	.30	62	.31	61	.30	64	.30	63	.30	62	.30	65	.27	64	.23	63	.19	67	.252	61.2	.167
25th	.20	69	.20	70	.21	57	.20	54	.25	66	.30	70	.32	63	.33	57	.33	57	.33	57	.33	56	.236	60.2	.153
26th	.52	57	.50	67	.50	67	.53	75	.54	76	.57	72	.65	70	.65	67	.65	66	.66	65	.66	64	.523	63.4	.431
27th	.86	60	.85	58	.85	59	.86	60	.87	68	.87	65	.87	64	.95	57	.95	56	.86	54	.86	51	.838	59.0	.758
28th	.71	43	.71	54	.71	63	.71	65	.72	69	.73	72	.73	67	.73	65	.73	65	.74	54	.74	55	.774	57.1	.698
29th	.74	63	.75	63	.75	67	.75	70	.75	70	.75	68	.75	62	.82	55	.82	56	.82	57	.82	55	.737	62.2	.647
*30th	.90	61	.90	57	.90	55	.90	54	.90	55	.90	58	.70	58	.90	52	.90	54	.90	55	.90	53	.880	52.8	.815
Means	.690	42.1	.684	42.4	.688	43.4	.687	44.6	.693	46.4	.697	46.7	.697	45.3	.695	43.9	.691	43.4	.681	42.7	.677	41.2	.680	41.6	
B. at 32°	29.654		29.647		29.649		29.644		29.645		29.649		29.652		29.654		29.651		29.644		29.643		29.645		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,

In October, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in cabin. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	.90	51	.90	50	.90	49	.90	48	.90	48	.90	50	.90	55	.90	55	.95	57	.90	56	.95	59	.95	53	.93	54
*2d	.93	49	.93	47	.92	46	.92	46	.92	45	.92	44	.92	45	.92	48	.93	63	.93	57	.92	50	.92	50	.93	52
3d	1.00	44	1.00	44	1.00	44	1.00	43	1.00	54	1.03	56	1.03	56	1.03	58	1.00	58	1.00	54	1.03	51	1.02	55	1.02	53
4th	.95	51	.95	48	.95	48	.95	47	.95	46	.95	45	.95	44	.95	57	1.00	57	1.00	55	1.00	55	1.00	54	1.00	56
5th	1.15	46	1.15	46	1.15	50	1.15	49	1.15	49	1.15	49	1.15	54	1.15	59	1.15	59	1.15	58	1.14	57	1.11	59	1.10	58
6th	.86	65	.83	61	.79	58	.76	58	.73	58	.70	56	.65	58	.64	62	.63	66	.60	63	.58	64	.57	63	.54	63
7th	.50	59	.50	59	.50	59	.50	56	.50	55	.50	55	.50	65	.50	64	.44	60	.44	59	.42	59	.38	63	.38	65
8th	.20	64	.20	60	.20	58	.18	52	.15	57	.15	58	.17	59	.15	65	.15	67	.15	66	.15	65	.15	63	.15	56
9th	.30	58	.30	58	.32	58	.33	59	.34	49	.35	52	.35	51	.35	58	.37	62	.40	64	.42	55	.43	53	.45	54
10th	.58	47	.58	48	.58	48	.58	47	.60	46	.60	45	.64	45	.65	46	.65	54	.65	50	.65	53	.65	56	.68	53
11th	.72	45	.70	43	.70	43	.70	46	.65	47	.65	48	.65	49	.65	49	.65	51	.65	50	.54	55	.53	53	.48	55
12th	.23	49	.23	48	.23	45	.23	44	.23	37	.23	37	.21	43	.21	57	.22	56	.22	54	.20	55	.20	58	.20	54
13th	.06	43	.05	41	.03	40	.03	39	.03	38	.03	37	.02	37	.02	36	.10	48	.10	49	.15	54	.16	53	.17	52
14th	.15	52	.17	49	.19	47	.18	45	.17	45	.16	47	.15	48	.15	49	.15	56	.14	58	.13	57	.10	56	.09	58
15th	.00	57	.04	51	.10	46	.14	44	.20	43	.25	51	.30	59	.31	62	.35	60	.41	61	.50	61	.54	62	.55	65
16th	.84	55	.86	49	.85	51	.88	48	.90	56	.90	48	.92	51	.95	52	.97	58	.97	58	1.00	56	1.00	52	1.00	55
17th	.92	52	.89	50	.85	48	.87	47	.87	45	.87	45	.87	50	.87	48	.86	47	.85	49	.84	50	.84	54	.90	55
18th	.60	50	.57	47	.55	45	.54	46	.50	44	.50	44	.50	45	.50	50	.48	50	.48	49	.48	50	.48	59	.48	57
19th	.74	52	.76	52	.80	50	.80	48	.82	50	.83	52	.82	52	.81	57	.80	53	.80	53	.80	52	.82	51	.84	50
20th	.74	50	.74	48	.71	47	.69	46	.67	45	.65	46	.62	45	.62	51	.60	52	.59	50	.57	52	.57	52	.55	53
21st	.55	52	...	(50)	.56	48	.56	50	.57	45	.57	42	.58	39	.60	43	.60	52	.65	53	.66	48	.64	49	.63	50
*22d	...	...	...	...	.76	45	.79	46	.84	45	.84	44	.83	47	.84	49	.84	49	.84	48	.84	48	.86	50	.86	49
23d	...	...	...	...	1.02	52	1.02	50	1.00	51	1.05	52	1.05	52	1.05	53	1.04	53	1.05	53	1.05	52	1.04	49	1.04	49
24th	1.00	46	1.00	45	.96	46	.95	47	.96	45	.96	44	.97	44	.97	47	.97	47	.97	49	.97	51	1.00	52	1.00	52
25th	1.05	48	1.05	48	1.05	47	1.05	44	1.05	44	1.05	44	1.05	37	1.05	42	1.05	55	1.04	53	1.01	49	1.01	52	1.07	50
26th	1.20	46	1.20	45	1.17	45	1.17	45	1.15	39	1.14	37	1.12	43	1.12	46	1.11	51	1.11	53	1.13	52	1.14	51	1.12	51
27th	1.09	48	1.05	46	1.05	45	1.05	48	1.05	56	1.05	44	1.05	43	1.05	52	1.05	49	1.05	48	1.05	46	1.05	46	1.05	50
28th	.95	46	.94	48	.95	44	.95	40	.99	37	.99	36	.96	40	.94	45	.95	46	.94	48	.93	48	.93	45	.90	44
29th	.85	46	.85	44	.85	43	.85	43	.85	44	.85	41	.85	42	.85	46	.84	47	.85	44	.83	46	.83	45	.84	46
30th	.95	52	.97	52	.97	51	.97	48	.98	46	.99	46	.99	45	.99	48	.99	46	1.03	44	1.07	46	1.06	44	1.06	43
31st	1.12	42	1.12	41	1.15	45	1.12	44	1.10	37	1.09	33	1.08	34	1.07	35	1.04	32	1.03	25	1.03	21	1.00	31	1.00	44
Means	.738	50.7	.737	49.0	.736	48.1	.736	47.2	.736	46.6	.739	46.1	.737	47.6	.737	51.3	.740	53.6	.742	52.6	.743	52.2	.741	52.7	.742	53.1
B. at 32°	29.680		29.683		29.684		29.686		29.688		29.693		29.686		29.677		29.674		29.679		29.680		29.677		29.677	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.93	55	.93	60	.93	57	.93	52	.93	53	.93	55	.93	56	.90	57	.93	56	.93	53	.93	50	.920	53.7	.853
*2d	.95	48	.95	47	.95	47	.95	55	.99	59	1.02	50	1.04	60	1.04	55	1.04	50	1.04	49	1.04	45	.959	50.3	.900
3d	1.00	50	.99	50	.99	50	.99	59	.99	61	.98	61	.98	59	.98	57	.98	55	.97	53	.97	52	.999	53.2	.932
4th	1.00	56	1.00	57	1.00	55	1.08	52	1.08	60	1.10	64	1.15	64	1.15	62	1.15	59	1.14	59	1.14	57	1.025	54.5	.955
5th	1.10	59	1.10	59	1.09	58	1.09	62	1.06	64	1.04	62	1.00	59	.96	59	.95	62	.95	66	.90	65	1.087	57.0	1.011
6th	.52	62	.52	68	.54	67	.54	64	.54	67	.53	66	.53	68	.52	62	.52	63	.51	62	.51	60	.611	62.7	.519
7th	.36	64	.34	64	.34	65	.33	67	.30	67	.31	67	.28	66	.28	63	.28	64	.27	64	.27	64	.392	62.2	.303
8th	.15	58	.15	59	.20	60	.22	64	.23	63	.27	63	.27	64	.27	62	.27	63	.27	64	.27	61	.197	61.3	.110
9th	.46	55	.51	52	.51	51	.52	52	.55	60	.57	59	.58	52	.57	52	.57	49	.59	49	.58	50	.447	54.7	.378
10th	.68	46	.67	43	.69	44	.69	49	.75	55	.75	56	.76	57	.75	48	.75	49	.75	47	.74	45	.670	49.0	.616
11th	.44	44	.40	42	.40	49	.40	52	.40	55	.38	60	.35	58	.35	58	.33	63	.33	57	.31	54	.515	51.1	.455
12th	.15	52	.13	46	.13	48	.13	53	.12	56	.12	56	.10	52	.10	49	.10	50	.10	46	.08	45	.171	49.6	.115
13th	.17	51	.20	48	.20	53	.25	62	.27	65	.29	62	.31	60	.32	52	.30	55	.30	55	.30	52	.161	49.2	.107
14th	.09	56	.06	54	.06	52	.05	55	.05	59	.05	59	.05	60	.04	59	.02	59	.00	59	.00	59	.100	54.1	.034
15th	.60	59	.65	61	.66	59	.70	60	.75	61	.77	61	.77	62	.79	61	.80	59	.83	59	.83	58	.493	57.6	.417
16th	1.00	51	1.00	51	1.01	50	1.00	50	1.00	55	1.00	58	1.00	54	1.00	52	.99	52	.98	52	.96	52	.958	52.8	.893
17th	.90	55	.81	44	.80	43	.80	53	.80	58	.75	58	.73	56	.69	53	.67	51	.64	50	.63	50	.813	50.5	.755
18th	.50	49	.50	45	.54	43	.60	51	.62	55	.65	54	.65	52	.67	53	.68	53	.70	53	.72	53	.562	49.9	.505
19th	.84	51	.82	48	.82	50	.80	51	.80	52	.82	56	.80	52	.79	52	.78	53	.75	53	.76	53	.801	51.8	.739
20th	.53	51	.53	53	.52	52	.55	51	.55	53	.55	57	.55	57	.55	55	.55	55	.55	54	.55	53	.596	51.2	.536
21st	.63	51	.67	42	.68	43	.68	44	.71	47	.74	50	.74	52	.75	52	.75	53	.75	53	.77	50	.650	48.3	.597
*22d	.86	51	.86	53	.95	48	.95	51	.97	52	.98	53	.98	54	.99	55	.99	56	.99	56	.99	59	.882	50.1	.825
23d	1.04	51	1.05	52	1.05	53	1.05	50	1.05	50	1.05	50	1.04	51	1.03	52	1.02	51	1.00	47	1.00	46	1.033	51.3	.973
24th	1.01	53	1.03	52	1.03	50	1.00	52	1.02	57	1.04	60	1.04	56	1.05	51	1.05	52	1.05	55	1.06	54	1.002	50.3	.943
25th	1.07	58	1.11	43	1.12	47	1.16	56	1.17	58	1.20	64	1.20	63	1.20	56	1.20	56	1.21	55	1.21	54	1.101	51.0	1.041
26th	1.12	47	1.10	45	1.09	49	1.10	50	1.10	52	1.10	55	1.09	54	1.10	56	1.10	53	1.10	50	1.10	50	1.124	48.5	1.070
27th	1.05	46	1.05	48	1.05	50	1.04	52	1.02	51	1.02	47	1.02	46	1.02	46	1.02	45	1.02	48	1.02	48	1.042	47.8	.991
28th	.90	44	.88	43	.88	47	.88	47	.88	47	.86	47	.86	46	.86	46	.85	46	.85	46	.85	45	.911	44.6	.868
29th	.84	44	.84	46	.84	46	.84	46	.84	48	.84	45	.84	45	.85	45	.85	45	.86	44	.86	49	.845	45.0	.801
30th	1.07	41	1.08	42	1.08	45	1.08	46	1.10	48	1.11	44	1.11	41	1.11	43	1.11	43	1.11	43	1.11	43	1.045	45.4	1.000
31st	1.00	50	1.00	44	1.00	46	1.00	40	1.00	42	1.00	43	1.00	42	1.00	39	1.00	41	1.00	47	1.00	46	1.040	39.3	1.011
Means	.741	51.9	.740	50.4	.747	50.9	.755	53.2	.763	55.8	.768	56.2	.766	55.4	.764	53.6	.761	53.6	.759	53.2	.757	52.3	.747	51.5	
B. at 32°	29.679		29.682		29.688		29.689		29.691		29.694		29.694		29.698		29.695		29.693		29.694		29.686		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,

In November, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Merenrial Barometer in cabin. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	1.00	45	1.00	45	1.00	45	1.00	45	1.00	43	1.00	42	1.01	43	1.01	45	1.01	46	1.01	47	1.02	44	1.02	40	1.03	44
2d	1.04	43	1.02	43	1.02	43	1.00	44	.98	44	.95	42	.92	41	.92	47	.89	47	.87	46	.83	45	.81	43	.80	45
3d	.80	42	.80	40	.82	40	.83	41	.84	38	.87	38	.87	39	.87	40	.90	49	.91	48	.90	41	.92	42	.92	41
*4th																										
5th																										
6th																										
7th																										
8th																										
9th																										
10th																										
11th	.90	60	.94	58	.90	56	.89	51	.78	46	.75	47	.70	47	.70	52	.70	52	.65	52	.62	53	.61	52	.60	58
12th	.60	58	.60	57	.60	55	.60	55	.60	53	.62	55	.65	58	.65	59	.73	59	.74	60	.74	57	.74	59	.75	56
13th	.80	58	.80	60	.80	54	.80	54	.80	54	.80	54	.80	59	.80	58	.71	62	.71	61	.74	55	.74	53	.75	50
14th	.70	54	.70	54	.70	53	.73	53	.75	54	.75	54	.76	56	.78	58	.84	57	.84	54	.84	51	.84	50	.79	51
15th	1.02	54	.99	56	1.03	51	1.03	53	1.02	56	1.02	56	1.02	55	1.02	51	.94	53	.99	50	1.00	49	1.00	47	1.00	50
16th	.95	61	.95	62	.95	52	.95	54	.95	57	.95	56	.96	59	.99	58	1.00	58	1.05	57	.99	51	.99	53	1.00	58
17th	1.00	57	1.00	56	1.10	49	1.10	48	1.10	50	1.10	51	1.10	52	1.10	53	1.10	58	1.09	57	1.09	54	1.09	53	1.00	58
18th	1.00	38	1.00	36	1.11	33	1.11	32	...	...	...	...	1.21	41	1.25	42	1.34	51	1.35	51	1.34	48	1.35	48	1.33	56
19th	1.20	62	1.17	60	1.15	43	1.08	41	1.09	40	1.05	35	1.00	48	1.00	50	1.00	53	1.00	54	1.00	52	1.00	56	1.00	58
20th	1.08	48	1.09	45	1.10	42	1.10	40	1.12	46	1.12	45	1.25	55	1.25	58	1.35	60	1.33	56	1.33	51	1.33	52	1.34	61
21st	1.43	46	1.43	43	1.42	42	1.41	41	1.37	39	1.35	35	1.31	42	1.31	49	1.31	43	1.29	48	1.23	47	1.18	48	1.15	52
22d	.76	49	.65	43	.64	41	.63	41	.60	40	.59	40	.55	42	.60	43	.56	45	.55	53	.53	49	.53	53	.53	60
23d	.55	46	.57	45	.60	44	.60	43	.60	42	.60	40	.60	41	.60	49	.55	51	.59	52	.64	47	.64	52	.67	56
24th	.67	52	.64	50	.64	48	.64	47	.60	45	.60	44	.60	51	.60	58	.61	60	.61	57	.59	54	.59	58	.59	59
25th	.70	47	.69	44	.73	49	.75	48	.75	47	.75	47	.75	45	.80	56	.81	63	.84	60	.84	60	.85	61	.87	62
26th	.85	52	.88	52	.89	45	.89	48	.87	46	.87	44	.87	41	.88	46	.89	60	.90	61	.90	56	.90	53	.80	52
27th	.87	56	.87	56	.83	45	.80	44	.77	44	.74	40	.74	49	.74	56	.73	58	.68	52	.66	51	.65	54	.62	54
28th	.20	50	.17	48	.13	46	.12	45	.10	42	.05	40	.05	45	.05	48	.05	56	.09	51	.09	54	.10	57	.10	57
29th	.50	47	.51	45	.53	44	.58	43	.58	42	.59	37	.65	40	.67	41	.70	52	.73	53	.72	52	.75	52	.76	50
30th	.90	53	.95	52	.94	51	.95	49	.95	46	.95	45	.98	49	.92	51	.95	55	.96	53	.97	51	.97	52	.97	53
Means	.849	51.2	.844	50.0	.853	46.6	.852	46.1	.842	45.6	.836	44.6	.841	47.7	.848	50.8	.855	54.3	.860	53.6	.853	51.0	.852	51.7	.842	54.0
B. at 32°	29.789		29.786		29.805		29.805		29.797		29.793		29.790		29.790		29.787		29.793		29.793		29.790		29.774	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	1.03	46	1.05	51	1.05	51	1.05	52	1.06	53	1.06	50	1.07	48	1.05	47	1.05	46	1.06	45	1.06	45	1.029	46.2	.981
2d	.80	46	.80	48	.80	48	.80	49	.80	48	.80	45	.80	46	.80	45	.80	43	.80	44	.80	44	.869	45.8	.823
3d	.92	44	.92	47	.92	47	.93	49	.90	49	.89	52	.85	51	.85	50	.85	51	.71	50	.70	45	.862	44.7	.819
*4th																									
5th																									
6th																									
7th																									
8th																									
9th																									
10th																									
11th	.60	57	.48	57	.41	57	.55	56	.52	57	.53	55	.55	56	.55	55	.55	55	.56	58	.56	57	.650	54.3	.582
12th	.75	58	.75	60	.75	61	.76	59	.76	58	.76	57	.76	55	.77	55	.76	54	.76	56	.76	59	.707	57.2	.631
13th	.73	54	.71	59	.71	59	.71	59	.71	57	.72	58	.70	56	.70	54	.70	55	.70	56	.70	57	.743	56.5	.669
14th	.77	50	.75	43	.75	52	.84	54	.96	55	.97	51	.98	51	.99	53	1.00	52	1.00	46	1.00	52	.834	52.4	.771
15th	1.00	51	.97	51	.96	52	.95	54	.95	55	1.00	51	1.00	52	.96	53	.95	52	.95	56	.94	57	.988	52.7	.924
16th	1.00	59	1.00	50	1.03	52	1.03	48	1.05	44	1.05	49	1.09	52	1.07	51	1.08	48	1.09	47	1.09	47	1.011	53.4	.944
17th	.98	61	1.08	57	1.11	61	1.12	58	1.11	58	1.10	51	1.10	50	1.11	52	1.11	49	1.11	44	1.11	40	1.084	53.2	1.018
18th	1.35	54	1.40	55	1.40	56	1.37	52	1.35	52	1.35	52	1.31	53	1.28	52	1.27	53	1.27	52	1.25	50	1.262	47.1	1.212
19th	1.00	60	1.00	59	1.00	59	1.03	63	1.04	62	1.04	61	1.05	60	1.04	56	1.06	52	1.06	50	1.07	48	1.047	53.5	.980
20th	1.35	63	1.39	60	1.45	64	1.49	62	1.50	66	1.50	61	1.45	57	1.45	54	1.45	51	1.45	49	1.44	46	1.321	53.8	1.253
21st	1.12	52	1.11	51	1.09	52	1.05	60	1.00	60	.95	57	.99	50	.85	51	.82	49	.75	47	.74	45	1.152	47.9	1.100
22d	.53	60	.53	58	.52	61	.52	59	.52	58	.52	55	.52	58	.52	56	.55	53	.56	51	.55	49	.565	50.7	.506
23d	.63	58	.68	58	.70	61	.85	59	.86	61	.74	60	.74	60	.72	57	.72	55	.72	54	.72	52	.662	51.8	.600
24th	.58	59	.60	62	.62	63	.65	64	.65	59	.65	62	.65	63	.68	60	.70	58	.71	55	.71	53	.632	55.9	.559
25th	.89	66	.89	63	.89	66	.92	56	.92	62	.90	62	.90	61	.90	59	.90	59	.90	56	.90	55	.835	56.4	.761
26th	.81	54	.78	54	.92	60	.92	59	.91	59	.90	60	.90	55	.91	53	.91	52	.90	50	.89	49	.881	52.5	.718
27th	.63	58	.58	65	.51	58	.51	58	.51	58	.43	57	.40	58	.35	59	.33	57	.25	55	.23	52	.601	53.9	.534
28th	.17	58	.20	59	.25	61	.26	57	.30	58	.30	60	.35	59	.36	56	.40	54	.42	51	.46	49	.199	52.5	.136
29th	.77	50	.85	54	.88	56	.88	54	.87	52	.91	56	.91	56	.93	56	.93	54	.94	55	.94	58	.753	50.0	.696
30th	.98	50	.99	54	1.00	50	1.00	55	1.00	54	1.00	58	1.00	58	1.00	55	.98	54	.99	52	1.00	52	.971	52.2	.908
Means	.843	55.1	.848	55.4	.857	56.8	.878	56.3	.880	56.3	.873	55.8	.873	55.0	.863	53.9	.864	52.4	.855	51.3	.853	50.5	.855	51.9	
B. at 32°	29.772		29.776		29.782		29.804		29.806		29.801		29.802		29.796		29.801		29.794		29.794		29.792		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR, In December, 1854, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in cabin. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	1.02	50	.95	48	.90	40	.90	39	.90	37	.91	31	.90	33	.90	37	.90	50	.97	60	.85	44	.85	43	.79	40
2d	.71	36	.71	35	.70	35	.70	34	.70	34	.70	33	.70	37	.69	42	.77	52	.80	50	.82	49	.84	43	.87	43
3d	.68	48	.70	44	.70	44	.69	42	.68	40	.68	39	.69	48	.70	58	.70	56	.70	54	.70	53	.70	51	.71	55
4th	.85	45	.85	44	.85	44	.85	42	.85	39	.86	35	.86	43	.86	51	.89	52	.89	53	.88	48	.88	50	.90	50
5th	.99	30	.99	28	1.00	26	1.05	25	1.12	25	1.12	24	1.11	40	1.12	47	1.14	46	1.15	46	1.16	45	1.15	50	1.12	47
6th	1.15	36	1.14	32	1.15	36	1.13	39	1.10	43	1.07	44	1.05	45	1.02	46	.96	48	.90	44	.88	46	.80	50	.75	54
7th	...	...	...	...	.40	42	.40	41	.40	43	.40	48	.41	51	.41	49	.41	49	.40	50	.40	49	.39	45	.39	43
8th	...	...	...	...	...	...	...	...	...	45	...	48	.70	59	.70	59	.75	60	.77	59	.82	60	.83	55	.85	53
9th	...	...	...	...	...	45	...	44	...	...	...	...	.75	42	.72	48	.67	59	.65	55	.60	43	.56	48	.50	50
*10th	...	...	...	...	.00	40	.00	43	...	...	...	...	*.94	48	*.96	49	*.97	58	*.98	57	*.99	57	*.99	57	.01	56
11th	...	...	...	...	.35	44	.39	44	.41	43	.45	42	.49	48	.50	48	.52	48	.53	42	.54	49	.53	49	.55	48
12th	...	...	...	...	.50	48	.45	48	.43	49	.41	50	.40	51	.36	51	.36	52	.35	52	.35	52	.36	50	.40	50
13th	...	...	.50	49	.50	50	.47	52	.43	53	.39	57	.35	58	.35	59	.35	57	.37	58	.40	56	.45	58	.47	56
14th	.70	48	.70	53	.70	54	.70	56	.70	60	.70	62	.71	64	.75	65	.78	60	.80	55	.80	47	.83	50	.83	51
15th	.84	56	.83	57	.81	57	.76	56	.72	52	.70	49	.70	50	.67	52	.65	54	.62	54	.58	49	.54	49	.54	51
16th	.71	50	.71	51	.76	49	.78	48	.80	46	.80	46	.80	45	.80	48	.81	50	.81	50	.81	51	.81	50	.85	50
17th	1.00	52	1.02	49	1.02	45	1.03	46	1.00	46	.99	45	.97	53	.96	53	.96	48	.96	49	.95	50	.93	51	.88	55
18th	.45	42	.45	40	.45	40	.45	37	.44	36	.44	36	.45	57	.47	56	.48	51	.50	52	.57	55	.62	57	.68	60
19th	.80	46	.80	45	.80	44	.80	44	.80	43	.80	43	.82	48	.83	52	.85	57	.85	57	.85	58	.86	61	.87	63
*20th	.73	46	.73	44	.73	41	.70	40	.68	39	.63	43	.57	48	.55	53	.50	58	.46	54	.41	51	.36	52	.32	55
21st	.21	45	.23	44	.24	43	.30	41	.35	39	.41	38	.47	52	.47	54	.50	65	.55	60	.57	60	.58	59	.59	60
22d	.76	44	.76	45	.76	45	.77	46	.77	44	.78	42	.78	55	.81	60	.85	62	.85	58	.88	57	.85	57	.85	59
23d	.86	45	.86	45	...	...	.87	43	.87	42	.85	42	.82	42	.80	60	.80	46	.80	41	.80	40	.80	40	.83	44
24th	...	...	.80	32	.80	32	.80	31	.80	31	.83	30	.85	32	.85	36	.85	40	.87	45	.87	42	.88	41	.91	37
25th	1.05	45	...	...	1.00	46	.98	39	.97	37	.95	35	.96	35	.95	46	.95	54	.92	55	.92	57	.92	59	.92	60
26th	1.02	48	1.02	45	1.02	44	1.02	40	1.02	37	1.02	35	1.02	34	1.02	48	1.02	49	1.03	43	1.05	41	1.07	41	1.05	44
27th	.93	45	.91	42	.87	40	.85	38	.83	39	.80	45	.79	50	.75	58	.73	54	.70	48	.65	46	.63	44	.61	48
28th	.41	40	.41	39	.40	39	.40	37	.47	39	.52	44	.56	48	.57	50	.59	54	.59	53	.59	54	.58	54	.58	55
29th	.55	53	.56	50	.56	47	.56	51	.56	53	.56	54	.57	55	.58	54	.58	56	.61	54	.65	52	.64	57	.65	59
30th	.97	45	1.02	44	1.05	43	1.07	43	1.07	42	1.05	40	1.03	48	1.05	50	1.05	51	1.03	53	1.01	55	1.00	57	1.00	56
31st	.82	61	.82	60	.82	54	.87	52	.92	50	.98	51	1.00	51	1.01	54	1.03	58	1.05	59	1.11	59	1.14	63	1.16	64
Means	.720	46.0	.724	44.7	.715	43.5	.716	42.8	.717	42.4	.717	42.6	.717	47.4	.715	51.4	.722	53.4	.725	52.3	.725	50.8	.722	51.3	.724	52.1
B. at 32°	29.674		29.681		29.675		29.679		29.680		29.680		29.667		29.655		29.656		29.662		29.666		29.662		29.662	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32°.
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	.79	40	.80	47	.80	48	.76	44	.75	43	.73	...	.72	...	.70	52	.70	...	.70	42	.71	...	.829	43.7	.789
2d	.87	48	.89	55	.89	54	.89	52	.90	51	.86	48	.83	45	.81	46	.78	45	.75	50	.75	49	.789	44.4	.746
3d	.74	55	.81	57	.81	53	.83	53	.85	53	.85	54	.85	55	.84	52	.84	46	.84	48	.85	48	.756	50.2	.698
4th	.91	51	.93	50	.95	49	.95	55	.95	56	.97	59	.97	57	.96	49	.96	45	.96	42	.97	29	.906	47.4	.855
5th	1.12	52	1.11	54	1.10	52	1.21	51	1.21	52	1.22	57	1.21	56	1.21	49	1.21	45	1.20	42	1.19	38	1.134	42.8	1.096
6th	.73	58	.71	55	.70	54	.65	53	.64	54	.60	53	.57	49	.50	45	.48	41	.44	52	.45	53	.815	47.1	.765
7th	.40	46	.40	49	.41	48	.42	52	.42	53	.42	52	.45	50	...	...	...	...	...	...	...	...	.425	47.9	.374
8th	.88	51	.88	50	.87	47	.90	46	.92	45	.91	45	.92	45	.92	46	.92	49	.92	50	.92	51	.799	50.3	.741
9th	.48	54	...	...	...	...	.34	50	.31	46	.26	45	.25	46	.17	47	.12	48	...	...	...	...	.512	47.9	.460
*10th	.04	58	.05	62	.10	63	.14	59	.16	58	.18	56	.22	55	.22	52	.25	49	...	...	...	...	.074	52.0	.012
11th	.58	51	.60	54	.60	52	.63	51	.64	53	.64	53	.64	51	.64	47	.64	49	...	...	...	...	.532	48.1	.480
12th	.40	51	.42	50	.46	47	.47	48	.49	53	.50	56	.50	54	.50	49	.49	50	...	...	...	...	.446	50.3	.388
13th	.49	59	.50	58	.55	58	.56	59	.59	59	.60	61	.63	60	.47	64	.54	50	.59	52	.64	45	.487	55.7	.415
14th	.85	51	.89	50	.90	54	.92	55	.93	53	.92	53	.91	52	.91	52	.91	51	.88	50	.86	49	.816	54.0	.749
15th	.53	52	.53	53	.56	51	.56	51	.58	52	.60	53	.64	53	...	...	...	...	...	...	...	...	.652	52.3	.589
16th	.87	53	.90	55	.91	54	.91	53	.91	54	.94	45	.95	48	.97	50	.99	51	.99	52	1.00	50	.858	50.0	.801
17th	.86	56	.85	57	.80	57	.80	55	.82	56	.82	59	.82	50	.82	50	.82	51	.80	50	.80	48	.903	51.3	.843
18th	.71	62	.75	64	.73	62	.74	59	.74	58	.74	48	.75	44	.75	42	.75	41	...	...	...	...	.611	49.4	.557
19th	.89	63	.90	59	.90	60	.88	65	.87	66	.85	65	.82	68	...	...	...	...	...	...	...	...	.830	55.4	.758
*20th	.29	61	.25	63	.24	62	.23	59	.22	58	.19	63	.19	60	.18	56	.18	53	.18	50	.20	46	.405	52.3	.341
21st	.62	61	.64	62	.67	64	.69	62	.70	61	.75	65	.75	60	...	...	.75	48	.75	48	.76	49	.554	53.9	.488
22d	.86	62	.87	65	.89	64	.90	60	.90	58	.87	50	.86	44	.83	48	.84	50	.86	46	.87	45	.834	52.7	.770
23d	.87	52	.80	45	.80	58	.80	59	.80	54	.80	58	.80	55	...	...	.80	46	.80	44	.80	40	.820	47.3	.770
24th	.94	31	.99	48	1.00	49	1.02	54	1.02	53	1.03	54	1.07	55	1.11	49	1.16	50	1.12	46	1.07	42	.935	41.5	.900
25th	.92	65	.92	68	.92	65	.92	60	.93	58	.91	56	.90	50	.87	50	.87	50	.90	50	1.05	45	.942	51.2	.882
26th	1.03	47	.98	51	1.00	53	1.03	55	1.05	54	1.04	53	1.03	48	1.00	45	1.00	45	1.00	43	1.00	40	1.022	45.1	.978
27th	.60	54	.60	57	.58	59	.54	57	.52	57	.50	55	.48	53	.47	50	.45	45	.45	42	.41	42	.652	48.7	.600
28th	.59	57	.60	60	.60	62	.60	63	.60	63	.60	60	.57	58	.55	55	.55	54	.54	55	.55	55	.542	52.0	.480
29th	.68	62	.70	63	.70	61	.75	62	.78	64	.79	65	.87	60	.95	55	.95	53	.94	50	.95	48	.695	55.7	.623
30th	1.00	54	.89	51	.85	53	.83	56	.84	57	.84	58	.84	57	.84	61	.83	62	.82	62	.81	63	.949	52.5	.885
31st	1.21	63	1.27	60	1.31	61	1.33	64	1.39	64	1.40	66	1.41	63	1.42	65	1.42	65	1.45	62	1.45	59	1.158	59.5	1.075
Means	.734	54.2	.737	55.6	.741	55.6	.748	55.6	.756	55.4	.753	55.2	.755	53.2	.745	51.4	.746	49.6	.745	48.6	.752	47.0	.732	50.1	
B. at 32°	29.666		29.665		29.669		29.676		29.685		29.682		29.689		29.685		29.690		29.692		29.703		29.675		

HOURLY ABSTRACT OF THE READINGS OF THE BAROMETER AND ATTACHED THERMOMETER AT VAN RENSSELAER HARBOR,

In January, 1855, in Lat. 78° 37′, Long. 70° 53′ W. of Greenwich.

Mercurial Barometer in cabin. 29 inches +. Readings in English inches and degrees of Fahrenheit.

Day.	1h.		2h.		3h.		4h.		5h.		6h.		7h.		8h.		9h.		10h.		11h.		Noon.		13h.	
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°
1st	1.45	55	1.45	53	1.45	51	1.45	50	1.45	49	1.45	49	1.45	48	1.45	57	1.45	60	1.45	62	1.45	65	1.45	63	1.45	62
2d	1.19	45	1.12	41	1.10	39	1.12	39	1.13	40	1.15	42	1.16	53	1.15	58	1.15	57	1.14	57	1.13	59	1.15	58	1.15	58
3d	1.25	46	1.24	43	1.22	40	1.21	38	1.20	39	1.19	42	1.19	45	1.16	47	1.15	49	1.15	56	1.15	58	1.14	59	1.14	58
4th	.92	48	.91	45	.89	43	.89	42	.87	41	.85	42	.85	56	.85	58	.79	57	.78	57	.78	55	.75	58	.75	59
5th	...	...	.74	40	.77	39	.79	38	.79	37	.80	37	.83	39	.86	44	.88	52	.89	50	.90	53	.93	54	.95	58
6th	...	...	...	...	1.05	38	1.05	35	1.09	33	1.17	32	1.19	36	1.22	47	1.28	51	1.30	50	1.32	52	1.43	54	1.43	55
7th	...	...	...	...	1.45	20	1.44	30	1.44	...	1.45	...	1.45	...	1.49	...	1.53	...	1.54	...	1.54	...	1.54	...	1.54	...
8th	1.44	...	1.43	46	1.40	...	1.38	...	1.34	...	1.31	...	1.27	...	1.22	...	1.18	...	1.16	...	1.14	...	1.12	...	1.09	...
9th	.75	51	.75	50	.78	43	.75	42	.75	41	.74	41	.74	40	.80	46	.78	42	.76	41	.75	44	.74	46	.74	48
10th	.80	46	...	...	.80	...	.78	...	.79	32	.80	32	.80	46	.80	50	.80	...	.80	...	.80	...	.80	...	.80	49
11th	1.00	...	1.00	...	.98	...	.99	...	1.01	37	1.06	40	1.08	44	1.08	50	1.09	...	1.10	...	1.12	...	1.13	...	1.14	...
12th	1.20	...	1.20	...	1.14	...	1.12	...	1.10	...	1.09	...	1.08	...	1.06	...	1.04	...	.99	...	.96	...	.94	...	.92	42
13th	.65	...	.65	...	.61	...	.61	...	.61	45	.60	45	.54	46	.54	46	.61	...	.62	...	.63	...	.63	...	.63	48
14th	.98	...	.97	...	.95	...	.96	...	.96	42	.95	42	.94	43	.95	44	.96	...	.95	...	.93	...	.91	...	.90	49
15th	.70	...	.72	...	.70	...	.68	...	.67	41	.66	40	.66	40	.66	42	.69	...	.70	...	.72	...	.74	...	.75	53
16th	.90	...	.91	...	.90	...	.90	...	.90	37	.89	38	.88	40	.86	45	.85	...	.85	...	.86	...	.86	...	...	...
17th	.90	...	.90	...	.89	...	.89	...	.89	41	.89	42	.90	49	.91	50	.93	...	.94	...	.95	...	.96	...	...	...
18th	.90	...	.91	...	1.23	...	1.22	...	...	...	...	...	1.19	49	1.17	50	1.15	...	1.14	...	1.14	...	1.15	...	...	...
19th	1.33	...	1.34	...	1.30	...	1.32	...	...	...	...	...	1.36	46	1.37	48	1 40	...	1.40	...	1.40	...	1.40	...	...	...
*20th	1.67	...	1.67	...	1.69	...	1.70	...	...	...	...	...	...	...	...	...	1.81	...	1.82	...	1.84	...	1.85	...	...	...
*21st	2.02	...	2.02	...	2.02	...	2.02	...	...	...	...	...	...	...	...	...	1.98	...	1.96	...	1.94	...	1.94	...	...	...
*22d	1.75	...	1.72	...	1.70	...	1.69	...	...	...	...	...	...	...	...	...	1.66	...	1.66	...	1.66	...	1.65	...	...	...
*23d	1.58	...	1.58	...	1.55	...	1.52	...	...	...	...	...	...	...	...	...	1.52	...	1.51	...	1.50	...	1.51	...	1.52	...
*24th	1.33	...	1.35	...	1.24	...	1.25	...	1.19	...	1.18	...	1.18	48	1.18	50	1.18	...	1.17	..	1.17	...	1.17	...	1.16	...
25th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
26th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
27th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
28th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31st	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Means	1.173	46.4	1.166	44.8	1.159	43.4	1.155	42.8	1.152	42.4	1.155	42.9	1.153	45.5	1.155	48.0	1 161	48.8	1.157	49.0	1 157	49.9	1.162	50.4	1 164	50.9
B. at 32°	30.125		30.123		30.119		30.117		30.115		30.117		30.108		30.103		30.107		30.102		30.100		30.103		30.104	
*	30.101		30.099		30.095		30.093		30.091		30.093		30.084		30.079		30.083		30.078		30.076		30.079		30.080	

Day.	14h.		15h.		16h.		17h.		18h.		19h.		20h.		21h.		22h.		23h.		Midn't.		Means.		B. 32.°
	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.	°	Inch.
1st	1.45	63	1.41	63	1.38	61	1.35	60	1.32	59	1.28	57	1.25	54	1.20	50	1.23	50	1.20	48	1.18	48	1.379	55.7	1.306
2d	1.16	59	1.19	60	1.20	61	1.20	61	1.21	60	1.22	58	1.23	57	1.24	55	1.24	54	1.24	54	1.25	48	1.176	53.0	1.109
3d	1.10	57	1.09	59	1.07	61	1.06	65	1.05	64	1.05	64	1.04	63	1.04	62	1.03	59	1.00	53	.94	51	1.119	53.2	1.051
4th	.75	60	.75	61	.75	60	.74	58	.74	58	.75	56	.75	53	.75	48	.75	52	.75	50	.76	50	.797	52.8	.732
5th	.95	60	.95	61	.86	62	.98	60	.99	58	1.05	55	1.12	52	1.23	50	1.26	45	1.29	46	1.32	48	.953	49.3	.898
6th	1.44	57	1.46	56	1.46	57	1.47	58	1.50	...	1.45	51	1.47	50	1.48	48	...	...	1.48	38	1.45	31	1.335	46.3	1.286
7th	1.54	...	1.53	...	1.53	...	1.53	...	1.53	...	1.52	...	1.50	...	1.47	48	1.47	50	1.47	50	1.45	50	1.495	38.4	1.468
8th	1.05	...	1.00	...	.98	...	.97	51	.95	55	.90	59	.88	56	.85	...	.82	50	.84	40	.80	50	1.105	49.9	1.046
9th	.76	49	.77	50	.79	50	.80	...	.80	...	.80	50	.80	52	.80	50	.80	50	.80	...	.80	46	.773	46.7	.724
10th	.80	50	.80	52	.80	51	.80	52	.80	51	.80	50	.80	48	...	...	.98	50	.98	...	.99	...	.825	46.5	.777
11th	1.16	...	1.18	...	1.19	...	1.20	...	1.20	...	1.23	...	1.24	...	1.20	48	1.20	46	1.20	...	1.20	49	1.124	46.6	1.076
12th	.90	43	.86	42	.82	44	.71	45	.70	46	.69	48	.69	46	.80	48	.70	48	.65	49	.65	...	.917	45.6	.872
13th	.65	50	.67	51	.70	49	.73	49	.77	50	.79	48	.83	51	.87	50	.91	44	.91	40	.92	40	.695	46.8	.647
14th	.90	50	.91	50	.93	49	.94	49	.94	50	.95	48	.95	47	...	...	...	...	...	...	...	...	.922	45.7	.876
15th	.75	54	.77	52	.79	50	.80	49	.81	50	.83	51	.83	49	...	...	...	...	...	...	...	...	.753	46.3	.706
16th	...	...	...	...	...	...	...	...	...	...	.85	50	.85	51	.84	54	.86	52	.87	50	...	...	.868	46.0	.822
17th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.20	50	1.20	46	1.19	56	1.16	50	1.017	48.5	.964
18th	...	...	...	...	...	...	1.15	...	1.14	...	1.18	47	1.20	48	...	...	...	...	...	...	...	...	1.163	48.7	1.109
19th	...	...	...	...	...	...	1.61	...	1.63	...	...	...	...	...	...	...	1.66	58	1.69	54	1.67	48	1.480	51.6	1.418
*20th	...	...	...	...	...	...	1.96	...	1.96	...	...	...	...	...	...	...	...	...	...	...	...	...	1.856	48.4	1.803
*21st	...	...	...	...	...	...	1.90	...	1.89	...	...	...	...	...	...	...	...	...	...	...	...	...	1.927	51.0	1.867
*22d	...	...	...	...	...	...	1.63	...	1.62	...	...	...	...	...	...	...	...	...	...	...	...	...	1.647	50.1	1.589
*23d	1.52	...	1.52	...	1.52	...	1.51	...	1.51	...	...	...	...	...	1.50	...	1.50	...	1.48	...	1.47	...	1.517	50.8	1.458
*24th	1.16	...	1.15	...	1.14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.155	49.0	1.100
25th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...*	1.148	49.1	1.092
26th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.445	50.7	1.386
27th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.499	52.5	1.434
28th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.482	52.3	1.417
29th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.964	52.8	.899
30th	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.592	51.3	.531
31st	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.360	49.1	.305
Means	1.166	51.6	1.168	51.9	1.167	51.9	1.172	51.9	1.173	51.9	1.175	51.4	1.177	50.8	1.185	50.4	1.186	49.0	1.182	47.9	1 174	47.4	1.166	48.6	
B. at 32°	30.104		30.106		30.105		30.110		30.111		30.114		30.118		30.127		30.131		30.130		30.124		30.113		
*	30.080		30.082		30.081		30.086		30.087		30.090		30.094		30.103		30.107		30.106		30.100		30.089		

NOTES TO PRECEDING ABSTRACTS.

September, 1853. During the whole month, the readings were taken from the aneroid barometer. They were converted by means of a table to the corresponding readings of the mercurial barometer.

11th. The dates before the 11th, were changed from nautical into civil reckoning.

14th. At 3 P. M., the aneroid barometer was removed from the cabin to the deck; a change of six feet of greater elevation.

19th. At 9 A. M., the barometer was brought from deck to cabin (six feet lower). During the hours 7 and 8 A. M., it became colder than the scale could register.

14th–19th. A correction of +0.006 inch has been applied to the barometer readings, to refer them to the level of the cabin.

October, 1853. 24th. From this day, the readings of the mercurial barometer are given. The position was in house on deck.

25th. Readings at 1, 2, 3, and 4 P. M., supplied from the aneroid in cabin.

January, 1854. 23d. The star prefixed to the hours between 9 A. M. and midnight, indicates that the decimals belong to 28 inches.

24th and 25th. The star indicates 28 inches as above.

February, 1854. 18th and 19th. The star in the place of the units indicates that the decimals belong to 28 inches.

June, 1854. 22d and 23d. The deck house was removed; the mercurial barometer, however, remained on deck.

July, 1854. 31st. Between 1 A. M. and 2 P. M., the readings of the aneroid appear to have been inadvertently inserted in the column for the mercurial barometer. In the abstract the readings were accordingly exchanged.

August, 1854. 27th. The readings of the two barometers between the hours 5 A. M. and 12 P. M. appear to have been accidentally exchanged, as indicated by the temperature readings. After 9 A. M. the aneroid was read, and its indications were changed to those of the mercurial barometer.

September, 1854. 4th. The sudden rise of the barometer between 6 and 7 A. M. is indicated by both instruments. There is apparently no cause for this singular change, so far as is shown by the remaining meteorological observations at these hours.

10th and 11th. Barometer not read during four hours, on account of the darkness.

14th. The readings at 7 and 8 P. M. were changed from 29.65 to 29.56; a correction confirmed by the aneroid readings.

30th. The barometer stand removed to the most forward stanchion of the cabin. Height above the water-line, one foot six inches.

October, 1854. 2d. The original record has the readings 30.2, 30.4, etc., for the hours 19 P. M., etc. It should evidently read 30.02, 30.04, etc., as given in the preceding abstract, and as confirmed by the aneroid readings. Similar mistakes in the displacement of a decimal have occurred in two or three other cases.

22d. Mercurial barometer in cabin against stanchions amidships. Height of cistern, six feet.

November, 1854. 4th to 10th. No record for this interval.

December, 1854. 10th. The star in front of the figures indicates that the decimal places refer to 28 inches.

20th. The mercurial and aneroid barometers were removed to-day; the mercurial barometer being placed six inches lower than before, and the aneroid placed two feet below it.

January, 1855. 20th, 21st, 22d, 23d, and 24th. The temperature readings for these days have been taken from page 422 of the second volume of the Narrative.

25th, 26th, 27th, 28th, 29th, 30th, and 31st. The barometer and temperature readings have been taken from the same page of the Narrative.

The last horizontal column of the reduced barometer readings is derived from the preceding column by subtracting 0.024 inch, so as to allow for the introduction of the means of the last seven days.

February, March, and April, 1855. For these months the original record could not be found. The daily and monthly means of the atmospheric pressure (and corresponding temperature), will be found in Appendix No. XII. of the second volume of the Narrative.

Diurnal Variation of the Atmospheric Pressure.—The following table exhibits the diurnal change of the barometric pressure, for each month of the year and for the whole year, as made out from the preceding abstract. For the months between September and January (inclusive), the mean from the two sets is given.

ABSTRACT OF THE MEAN HOURLY READINGS OF THE (REDUCED) BAROMETER AT THE LEVEL OF THE SEA, FROM OBSERVATIONS AT VAN RENSSELAER HARBOR, BETWEEN SEPT. 1853 AND JAN. 1855.

Atmospheric Pressure in English inches.

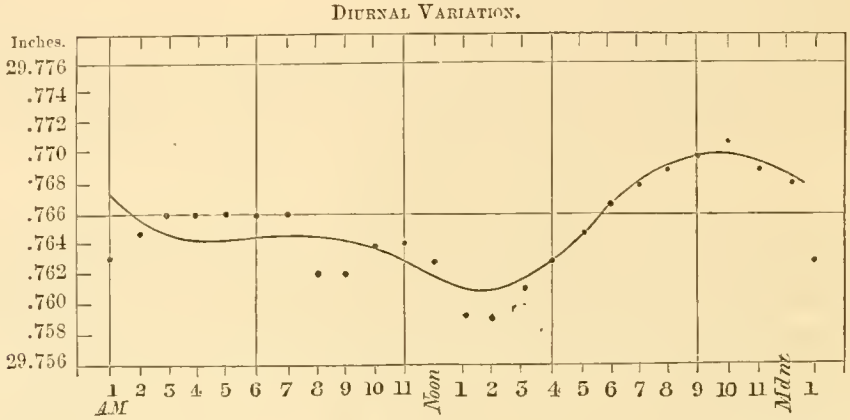
Hour.	Sept. 1853–54.	Oct. 1853–54.	Nov. 1853–54.	Dec. 1853–54.	Jan. 1854–55.	Feb. 1854.	March. 1854.	April. 1854.	May. 1854.	June. 1854.	July. 1854.	Aug. 1854.	Means.
1h.	29.642	29.751	29.751	29.749	29.781	29.637	29.784	29.968	29.939	29.716	29.750	29.687	29.763
2	.646	.753	.756	.754	.782	.636	.789	.971	.939	.717	.746	.690	.765
3	.652	.752	.767	.753	.778	.632	.792	.973	.941	.715	.743	.689	.766
4	.650	.753	.766	.757	.775	.632	.798	.975	.936	.718	.741	.689	.766
5	.652	.748	.757	.756	.775	.646	.800	.978	.934	.720	.734	.697	.766
6	.650	.751	.756	.756	.777	.647	.798	.977	.930	.718	.733	.696	.766
7	.653	.750	.754	.750	.772	.651	.798	.979	.932	.719	.737	.694	.766
8	.649	.745	.749	.741	.766	.647	.793	.977	.935	.721	.736	.690	.762
9	.654	.744	.747	.740	.768	.646	.798	.979	.941	.705	.733	.694	.762
10	.656	.746	.749	.743	.766	.655	.802	.981	.942	.704	.734	.690	.764
11	.657	.750	.750	.745	.764	.653	.796	.978	.940	.712	.739	.689	.764
Noon	.657	.746	.748	.743	.765	.648	.798	.978	.933	.718	.737	.687	.763
13	.656	.750	.742	.735	.765	.644	.794	.970	.931	.714	.725	.685	.759
14	.656	.747	.741	.735	.766	.648	.794	.969	.934	.714	.723	.684	.759
15	.652	.747	.742	.738	.766	.661	.803	.973	.934	.714	.724	.681	.761
16	.655	.750	.748	.739	.767	.662	.800	.976	.935	.711	.730	.681	.763
17	.655	.754	.747	.748	.770	.671	.802	.976	.935	.709	.736	.685	.765
18	.660	.753	.755	.753	.772	.671	.803	.980	.931	.708	.733	.684	.767
19	.659	.755	.753	.750	.774	.674	.805	.983	.935	.712	.735	.685	.768
20	.660	.758	.752	.754	.777	.669	.810	.987	.935	.710	.734	.685	.769
21	.660	.756	.755	.752	.782	.668	.806	.985	.939	.712	.740	.688	.770
22	.658	.754	.760	.756	.787	.666	.803	.984	.941	.713	.742	.690	.771
23	.654	.750	.756	.755	.785	.669	.794	.981	.943	.715	.739	.692	.769
Midn't	29.651	29.749	29.755	29.760	29.784	29.666	29.791	29.980	29.947	29.716	29.734	29.689	29.768
Means	29.653	29.750	29.753	29.748	29.773	29.654	29.793	29.977	29.937	29.714	29.736	29.689	29.765

Owing to the small amplitude, the comparatively short period of observation, and the magnitude of the occasional disturbances, the law of the diurnal variation is apparently subject to considerable fluctuations; and it has, therefore, only been attempted to express the figures in the last vertical column, or the mean variation, analytically. Using Bessel's formula, the variation can be expressed by the formula:—

$$\underset{\text{Inches.}}{29.765} + \underset{\text{Inch.}}{0.0034}\ \sin\ (\theta + 290°) + \underset{\text{Inch.}}{0.0022}\ \sin\ (2\,\theta + 204°);$$

the terms containing $3\,\theta$, etc., becoming too small to have any real value. The angle θ counts from noon, and is expressed in degrees at the rate of 15° an hour.

The annexed diagram exhibits the observed (by dots) and the computed (by a fine line) diurnal variation. Its principal feature is the afternoon inflection, with a



maximum pressure at about 10 P. M. The principal minimum is reached at 1 P. M. The 10 P. M. maximum is in strict conformity with the general law deduced from observations in the northern hemisphere. The 1 P. M. minimum seems to occur about three hours earlier than indicated by more southern stations. Kaemtz takes as amplitude of the diurnal variation, the difference between the mean of the maxima and the mean of the minima. Other meteorologists take the maximum difference. According to this latter view, we have the diurnal amplitude 29.7701 — 29.7604 = 0.0097 inches. The diurnal fluctuation here considered is the change in the gross pressure of the atmosphere, there being no means on hand for separating the pressure of dry air from the pressure of aqueous vapor.[1]

In connection with this subject, it may be stated that the latitude of Van Rensselaer Harbor is about 14° higher north, than the latitude (64°) in which the mean height of the barometer is a minimum (at the level of the sea).

Annual Fluctuation of the Atmospheric Pressure.—The following is an abstract of the monthly means of the barometer readings (reduced to 32°). The values for February, March, and April, 1855, were taken from the second volume of the Narrative.

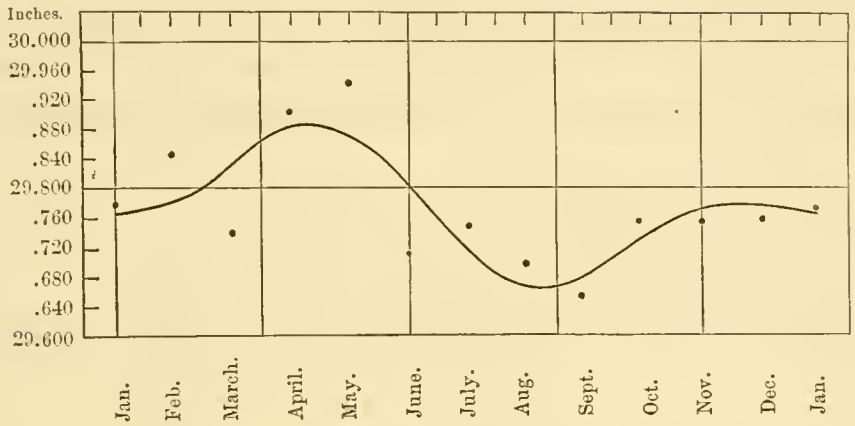
Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1853	...	...	...	...	...	...	...	...	29.662	29.815	29.713	29.821
1854	29.458	29.654	29.798	29.977	29.937	29.714	29.736	29.689	29.645	29.686	29.792	29.675
1855	30.089	30.032	29.693	29.820	...	...	...	...	...	...	...	...
Means	29.773	29.843	29.745	29.898	29.937	29.714	29.736	29.689	29.653	29.750	29.753	29.748

According to the resulting values, the height of the barometer is above the mean in the months of January, February, March, April, and May, and descends below the mean in the remaining summer and autumn months. The maximum pressure

[1] Although a long series of hygrometric observations were made, yet, owing to the peculiar delicacy which such observations require in a latitude of such low temperature, they proved, on close examination, too uncertain to be relied on in their results.

was observed in May, the minimum in September. The range between these two months is 0.284 inch.

Annual Variation.



According to the above diagram, in which the dots indicate the mean monthly readings, the law of the annual fluctuation does not, perhaps, as plainly appear as we might expect from a longer-continued series of observations. In the month of January, for instance, we have a difference in the height of the barometer in the two years (1854 and 1855) of not less than 0.631 inch.

The general law that the height of the barometer is less in summer than in winter, is here prominently brought out. In the following expression, I have attempted to exhibit the course of the annual variation:—

$$B = \overset{\text{Inches.}}{29.770} + \overset{\text{Inch.}}{0.079}\ \textit{sin}\ (\theta + 4°) + \overset{\text{Inch.}}{0.044}\ \textit{sin}\ (2\,\theta + 194°),$$

the angle θ counting from January 1st, and is expressed in degrees at the rate of 30° a month.

The computed annual range is 29.875 — 29.668 = 0.207 inch. If we add 0.005 as correction to the constant 29.770, to refer it to the level of the sea, we find the mean barometric height, in the latitude 78° 37′ N., 29.775 inches.

Irregular Oscillations of the Pressure; Monthly and Annual Extremes.—The irregular changes in the atmospheric pressure are, like those of the temperatures, much greater in winter than in summer, of which an instance has already been given (see the means for the months of January and February of 1854 and 1855). If we deduce the average difference, irrespective of sign, in the barometric height between any two consecutive days, we obtain the following table of mean diurnal change, as made out from 17 months of observations:—

	Inch.		Inch.
January	0.17	August	0.10
February	0.26	September	0.11
March	0.17	October	0.15
April	0.12	November	0.17
May	0.14	December	0.26
June	0.10		
July	0.09	Mean	0.15

In the months of December, January, and February, the variability between successive diurnal means is a maximum, and in the months of June, July, and August, it reaches a minimum value; the ratio of the highest and lowest being as 2½ to 1.

The following table contains the maxima and minima of atmospheric pressure as observed in each month, and the extreme ranges for each month of the year:—

Month.	Maxima.			Minima.			Range.
	1853.	1854.	1855.	1853.	1854.	1855.	Inches.
September	30.06	30.25	...	29.07	29.01	...	1.11
October	30.50	30.16	...	29.11	29.00	...	1.28
November	30.26	30.41	...	29.05	29.01	...	1.30
December	30.50	30.37	...	29.01	28.89	...	1.48
January	...	29.92	30.97	...	28.86	(29.30)	1.36
February	...	30.45	...	...	28.84	...	1.61
March	...	30.49	...	...	29.18	...	1.31
April	...	30.37	...	...	29.28	...	1.09
May	...	30.49	...	...	29.19	...	1.30
June	...	30.19	...	...	29.41	...	0.78
July	...	29.97	...	...	29.40	...	0.57
August	...	30.05	...	...	29.22	...	0.83

Mean range of monthly extremes 1.17 inch; the maxima rise, on the average, to 30.31 inches, and the minima fall to 29.14 inches. As in the preceding table of the diurnal fluctuation, the greatest monthly range takes place in December, January, and February (1.48 inch), and the least in June, July, and August (0.73 inch). The ratio of highest and lowest values is as 2¼ : 1. Between the extremes, both tables show a regular progression.

The absolute highest reading was 30.97 inches; it occurred in the morning of January 22st, 1855. The absolute lowest reading was 28.84 inches, and occurred near noon of February 19th, 1854. Extreme range observed 2.13 inches.

Of the gales noted in my discussion of the winds at Van Rensselaer Harbor,[1] only the following ones were accompanied by a notable amount of change of atmospheric pressure:—

Before the setting in of the gale of December 28th, 1853, the barometer fell 0.35 inch in nine hours, or at a rate of 0.04 inch an hour. For three days preceding the gale of October 15th, 1854, the barometer was very low, and reached its lowest point at the hour when the gale was at its height; after this time, it rose 0.77 inch in eighteen hours, or at a rate of 0.04 inch an hour. Before the gale of December 18th, 1854, the barometer fell 0.36 inch in five hours, or 0.07 inch an hour; and before the setting in of the gale of January 13th, 1855, it fell 0.26 inch in eleven hours.

State of the Barometer during the Fall of Snow (or Rain).—To ascertain whether there is any change in the barometric pressure caused by the fall of snow, I have tabulated the readings during the hours of precipitation, and compared them with an equal number of readings, half immediately preceding, half immediately follow-

[1] See record and results of my discussion of the observations of winds at Van Rensselaer Harbor, in Vol. XI. of the Smithsonian Contributions to Knowledge.

ing, each fall of snow. If snow fell for less than three consecutive hours, I have taken no notice of it in this investigation. The mean result from 563 hours of comparison, gave only a difference of 0.006 inch, by which quantity the barometer is lower during the fall of snow than otherwise.

Variability of Atmospheric Pressure with the Direction of the Wind.—The connection of the atmospheric weight with the direction of the wind requires, in order to find its average effect, a great number of observations, particularly on account of the irregular oscillations of the barometer in the winter months. The following results are derived from a comparison of the barometric readings at the hours 6 A. M., noon, 6 P. M., and midnight, for each day, with the respective mean monthly reading during 17 months of observations. These difference were then arranged according to the directions of the wind. The result is as follows (± indicating $\left\{\begin{matrix}\text{above}\\\text{below}\end{matrix}\right\}$ the mean):—

Magnetic direction.	Inch.	
N.	—0.022	
N. E.	+0.072	On account of the comparatively small number of observations for these directions, they may be combined: E. N. E. —0.044 in.
E.	—0.100	
S. E.	0.000	
S.	+0.038	
S. W.	+0.045	
W.	—0.031	
N. W.	—0.031	

From 1050 comparisons of calms and barometric readings, the latter were found 0.005 inch above their mean value.

It is only during S. and S. W. (magnetic) winds that the barometer rises above the mean value; during all other winds it is depressed.

Relation of the Atmospheric Pressure to each Wind and to the Temperature of the same.—To show this dependence, it is best to put the relation of the atmospheric pressure, as well as that of the temperature, to the winds, in an analytical form. In my discussion of the observed temperatures at Van Rensselaer Harbor, a table was made out showing the dependence of the temperature on the direction of the wind. If we deduct the mean elevation of temperature by the winds from each separately, we obtain the following table of the effect of each wind on the temperature (± indicating an $\left\{\begin{matrix}\text{elevation}\\\text{depression}\end{matrix}\right\}$ of temperature):—

Magnetic direction.		Magnetic direction.	
N.	—1°.4	S.	+0°.6
N. E.	0.0	S. W.	+0.4
E.	—0.1	W.	+0.1
S. E.	+0.9	N. W.	—1.4

Counting θ from the north (or belonging to a (magnetic) north wind) round by E. to 360°, we obtain, by using Bessel's formula,

$$T = +1°.02 \sin (\theta + 286°);$$

or, for the true directions,

$$T = +1°.02 \sin (\theta + 34°);$$

and similarly, from the barometric relation to the winds,

$$B = +0.018 \text{ in. } \sin (\theta + 354°).$$

A comparison of the angular constants in these two expressions does not show a correspondence of the wind of maximum temperature with a minimum pressure; on the contrary, there is a much nearer correspondence of the wind of maximum temperature with maximum pressure. According to the first formula, the hottest wind is from the direction N. E. $\frac{1}{2}$ E. (true); and, by the second formula, the maximum atmospheric pressure is from the direction E. (true) nearly.

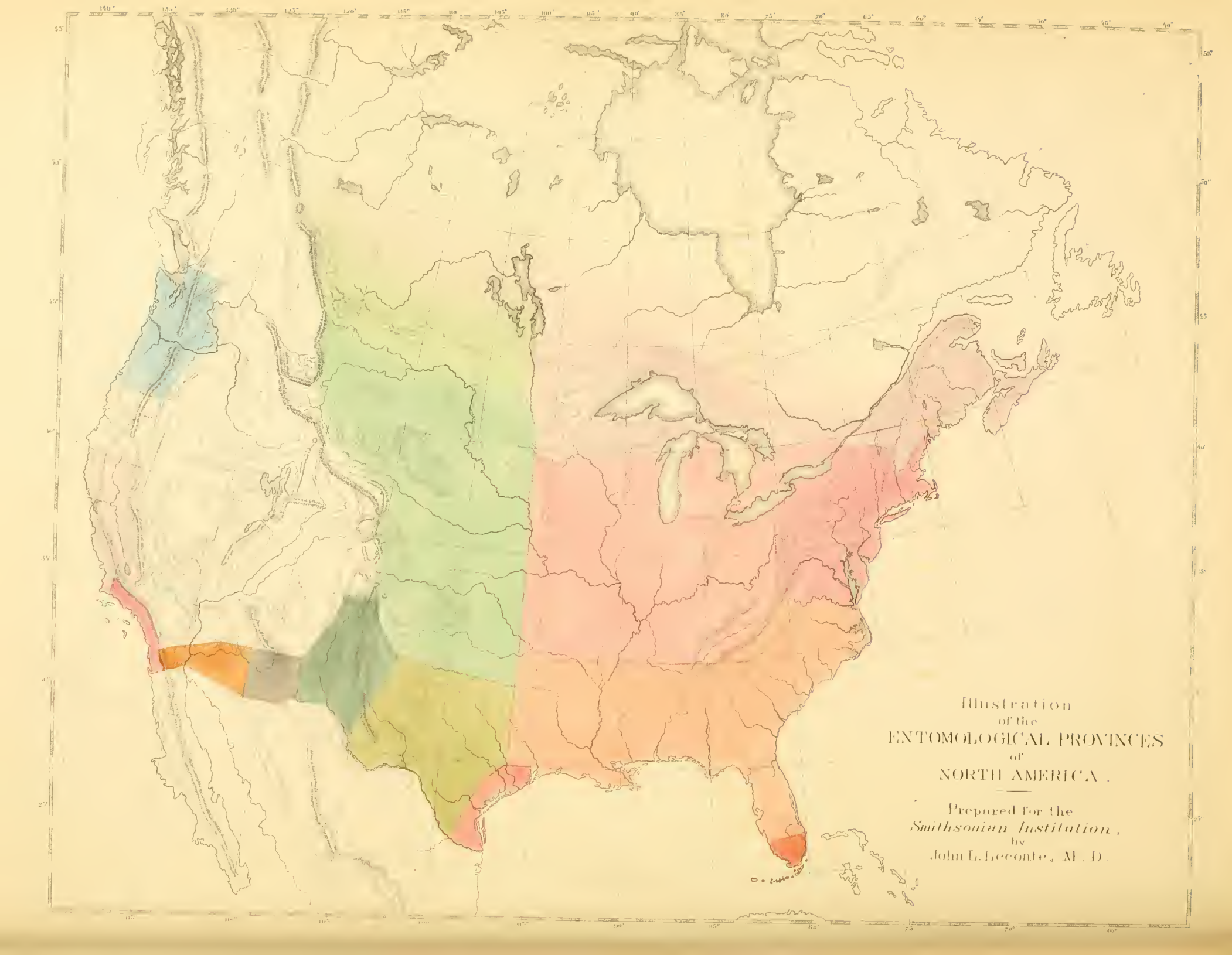


Illustration
of the
ENTOMOLOGICAL PROVINCES
of
NORTH AMERICA.
Prepared for the
Smithsonian Institution,
by
John L. Leconte, M. D.

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

THE

COLEOPTERA

OF

KANSAS AND EASTERN NEW MEXICO.

BY

JOHN L. LE CONTE, M. D.

[ACCEPTED FOR PUBLICATION, OCTOBER, 1859.]

COMMISSION

TO WHICH THIS MEMOIR HAS BEEN REFERRED.

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INTRODUCTION.

The present memoir is intended to give a catalogue of the Coleoptera thus far known to inhabit the middle eastern portion of the great central region of temperate North America. The boundaries of the province here treated of are as follows: north by the Missouri river, east by the meridian of the mouth of the Kansas or Platte river, south by about latitude 34°, and west by the main mass of the Rocky mountains.

It thus includes Kansas, a portion of Nebraska, and the eastern part of New Mexico. The eastern limit of this province is well defined; the other boundaries are indefinite, since it there fades imperceptibly into other provinces of the same great zoological district.

Before proceeding to consider the special material used in the preparation of this memoir, it will be proper to give a short sketch of the general results thus far obtained regarding the geographical distribution of Coleopterous insects in the territory of our republic.

The whole region of the United States is divided by meridional, or nearly meridional lines into three, or perhaps four, great zoological districts, distinguished each by numerous peculiar genera and species, which, with but few exceptions, do not extend into the contiguous districts. The eastern one of these extends from the Atlantic Ocean to the arid prairies on the west of Iowa, Missouri, and Arkansas, thus embracing (for convenience merely) a narrow strip near the sea-coast of Texas. This narrow strip, however, belongs more properly to the eastern province of the tropical zoological district of Mexico.

The central district extends from the western limit of the eastern district, perhaps to the mass of the Sierra Nevada of California, including Kansas, Nebraska, Utah, New Mexico, Arizona, and Texas. Except Arizona, the entomological fauna of the portion of this district west of the Rocky mountains, and in fact that of the mountain region proper, is *entirely* unknown; and it is very probable that the region does in reality constitute two districts bounded by the Rocky mountains, and southern continuation thereof.

The western district is the maritime slope of the continent to the Pacific, and thus includes California, Oregon, and Washington territories.

These great districts are divided into a number of provinces, of unequal size, and which are limited by changes in climate, and therefore sometimes distinctly, sometimes vaguely defined.

The Atlantic district may be divided into: 1, a northern province, including Maine, Eastern Canada, Nova Scotia, Newfoundland, etc., and extending west-

wardly from Lake Superior to Lake Winnipeg and Western Canada, which fades insensibly into the great Arctic district; 2, a middle province, limited westwardly by the Appalachian chain, and extending to Southern Virginia; 3, a western province, including Minnesota and the States of the valley of the Mississippi, as far as the State of that name; 4, a southern province, including the States south of Virginia and Kentucky; 5, a subtropical province, including the point of the peninsula of Florida; 6, a subtropical province, including the sea-coast of Texas.

The Central district, as far as known, may be thus divided: 1, a northern province, comprising the regions north of the Missouri, the plains of the Saskatchewan, etc.; 2, a middle eastern province, divided into two subprovinces, including: *a*, Kansas, and Nebraska; *b*, northeastern New Mexico; 3, a southeastern province, including Texas, with the exception of province six of the Atlantic district; 4, a southwestern province, including the upper part of the valley of the Gila; and 5, a south-southwestern province, including the lower Gila and Colorado. The unexplored portions of this district will indicate middle western, and northwestern provinces, or perhaps the necessity of constituting with them and the southwestern province a district to be called the Interior district.

The Pacific district may be divided as follows: 1, a hyperborean province, consisting of Sitka and the neighborhood; 2, a northern province, including Eastern Oregon and Washington Territories; 3, a middle province, including California, probably as far south as Santa Barbara; 4, a southern province, including California from Santa Barbara to San Diego, extending to the crest of the Sierra. Southern, or lower California is also, perhaps only in part, a province of this district;[1] but, as yet, no collections of magnitude have been received therefrom. Other provinces will, from the peculiar method of distribution of species in that portion of America, be defined when more full collections are made, but at present cannot be indicated.

At the north, the Atlantic and Central districts seem to merge imperceptibly together, about the valley of the Athabasca, and Winnepeg rivers, and finally to disappear in the limited Arctic fauna; the hyperborean province of the Pacific district also fades into this Arctic fauna, without, however, losing itself so perfectly in the northern provinces of the other districts. We have thus evidence that the American Arctic district may be divided into two provinces, an eastern and a western.

At the south, the Atlantic district merges through Florida into the Caribbean tropical province, and through maritime Texas into the Mexican lower eastern province. In the same direction the Central district merges into the Mexican upper or central province, and the Interior district, towards the Gulf of California, into the Mexican western province. Regarding the southern affiliations of the Pacific district we know absolutely nothing; scarcely a single species found at San Diego has been found in Mexico.

[1] A few species, collected by John Xantus, Esq., at Cape San Lucas, though all new, indicate a greater resemblance to the fauna of the lower Colorado, than to that of maritime California; this province may therefore be found eventually to belong to the interior district.

The method of distribution of species in the Atlantic and Pacific districts, as already observed by me in various memoirs, is entirely different. In the Atlantic district, a large number of species are distributed over a large extent of country; many species are of rare occurrence, and in passing over a distance of several hundred miles, but small variation will be found in the species obtained. In the Pacific district, a small number of species are confined to a small region of country; most species occur in considerable numbers, and in travelling even one hundred miles, it is found that the most abundant species are replaced by others, in many instances very similar to them; these small centres of distribution can be limited only after careful collections have been made at a great number of localities, and it is to be hoped that this very interesting and important subject of investigation may soon receive proper attention from the lovers of science on our Pacific shores.

In the Central district, consisting, as it does to a very large extent, of deserts, the distribution seems to be of a moderate number of species over a large extent of country, with a considerable admixture of local species; such at least seems to be the result of observations in Kansas, Upper Texas, and Arizona.

For the purpose of enabling these investigations to be carried on in future with less labor, I have caused the catalogues of the present memoir to be printed separately; the small size of the catalogue of species from Eastern New Mexico, will call attention to the necessity of procuring more material from that region; while the asterisks affixed to the species which have occurred in both sub-provinces, will give the results thus far obtained in geographical distribution.*

For many years in the early history of entomology in the United States, the Coleoptera of Kansas were as well known, and even more fully described than those found in the Atlantic States. They form, indeed, the subject of one of the earliest and most extensive of the valuable contributions to entomology made by Say.

Having, in the year 1845, made a journey along the Platte river to Fort Laramie, thence near the base of the mountains to the Arkansas, returning by that river and the Santa Fé road, I was enabled to follow nearly in the footsteps of Say, and had the singular good fortune to recover nearly all the species described by him, and of which the types had been destroyed to such an extent that scarcely an authentic specimen remained.

Of the species described by him, and not obtained by me from this region, I have introduced those which remain unknown to me, marking them thus (fide Say); the others I have excluded, as I possess them from Missouri, the locality in most

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* The student will also consult in reference to the Coleopterous fauna of the Central and Pacific districts: 1. My report on the insects collected along parallel 47°, in Pacific R. R. Explorations and Surveys, vol. xi., which includes a list of the species found on the Pacific Slope, north of San Francisco; an appendix to the same in Proceedings of the Academy of Natural Sciences of Philadelphia, October, 1859.

2. Catalogue of Coleoptera of the region adjacent to the boundary line between the United States and Mexico; Journal of the Academy of Natural Sciences of Philadelphia, second series, vol. iv., No. 1.

3. Catalogue of the Coleoptera of Fort Tejon, California; Proceedings of the Academy of Natural Sciences of Philadelphia, February, 1859.

instances given by Say, and have no evidence that they are found within the region herein considered.

The results of my own labors have been measurably increased by the following collections, which I owe to the kindness of friends, and to the Smithsonian Institution:—

1. Collections brought by Lieut. Beckwith's expedition; among which were two new species; Cleonus *angularis*, and Cœlocnemis *punctatus* Lec. (Proc. Acad. Nat. Sc. Philad., VII, 225). The genus Cœlocnemis was not previously known east of California, where it is represented by several species; suspecting that it was collected inside of the Great Basin, I have excluded it from the catalogues here given.

2. A large number of specimens collected in Eastern Kansas, by Mr. M. Burke, and presented to me through Dr. John Torrey.

3. A very large collection made at Fort Riley, Kansas, by Dr. W. A. Hammond, U. S. A., and John Xantus, Esq.

4. Collections from the mouth of the Yellowstone river, and from the Loup Fork of the Platte, made by Dr. F. V. Hayden, and received from the Smithsonian Institution.

5. A collection made by Dr. Wm. A. Hammond, on the route from Fort Riley to Bridger's pass.

6. Similar collections made by Dr. John G. Cooper, received from the Smithsonian Institution.

The materials received from Eastern New Mexico are much more scanty, and are as follows:—

1. Four or five hundred specimens collected near Santa Fé, by Mr. Fendler, and procured for me by the kind offices of Dr. Engelmann.

2. Specimens collected by Dr. Wislizenus, on a journey from Santa Fé to Chihuahua; though few in number, these specimens were very interesting in character, and I have availed myself of the present opportunity to figure some of them, though they are possibly not found within this province of the Central district, but belong rather to the southwestern province.

3. A small, but very interesting collection made in the vicinity of Santa Fé, by the late R. C. Kern, and given me by Prof. S. S. Haldeman.

These materials were used in preparing articles for the reports of the expeditions of Capt. E. G. Beckwith, and Capt. J. Pope, U. S. A., in Pacific R. R. series, but were excluded from want of room, and are now incorporated together, with the addition of several new species since obtained from various sources.

The six provinces of the Atlantic district are marked on the map by red tints; the two provinces and two subprovinces of the Central district proper by green; the two southern provinces of the supposed Interior district by brown; and the four provinces thus far ascertained of the Pacific district by blue tints.

COLEOPTERA OF KANSAS AND EASTERN NEW MEXICO.

AMBLYCHILA Say.

A. cylindriformis Say, Trans. Am. Phil. Soc. IV, 409.

The specimen figured (Tab. II, fig. 1), was found by Capt. Pope on the Llano Estacado; it is very large (1·28 inches long), and in form is altogether similar to the specimen figured by me in the Proceedings of the Academy of Natural Sciences, vol. vii. p. 32. The punctures of the elytra are however much stronger, being in fact hardly smaller than those which are scattered in irregular series. The costæ of the elytra are more elevated, and the internal one extends fully to the posterior declivity. The legs are thicker, and the posterior tibiæ are entirely straight. Two other specimens were collected by Dr. Wm. A. Hammond, U. S. A., on the Platte river, about 100 miles above Fort Kearny. They agree in sculpture with the specimen from the Llano Estacado; one of them, which I consider as a male, has rather narrower elytra than the other, and has also the thorax more rounded on the sides: otherwise there is no difference between them. A larger series of specimens will indicate the nature of the strongly-marked differences of sculpture.

As confirming the correctness of the view expressed by Lacordaire regarding the identity of *A. cylindriformis* with the Californian *A. Piccolominii*, I may add, that having sent to Baron Chaudoir a figure and description of the labrum of the specimen found at Fort Union by Major Sibley, I was informed by that distinguished entomologist that he can find no appreciable difference between the figure and the labrum of the Californian specimen now in his cabinet. The figure given by M. Reiche is therefore incorrect, as already surmised.

MICRIXYS Lec.

M. distinctus, rubens, flavo-pilosus, capite thoraceque grosse punctatis, hoc transverso obovato, postice valde, angustato, lateribus valde rotundatis, elytris dorso subdepressis, striis valde cribratis, maeula transversa laterali ad medium ornatis, apice summo, pedibus are antennisque piceis, his articulo 1mo rufo. Long. ·3. Tab. II, fig. 2.

Micrixys distinctus Lec. Proc. Acad. Nat. Sc. VII, 220.

Panagaeus distinctus Hald. Stansbury's Expedition to Great Salt Lake, 373.

Eugnathus || *distinctus* Lec. Trans. Am. Phil. Soc. X, 375.

New Mexico: one specimen found by the late Richard Kern, Esq. This genus, unfortunately established under a preoccupied name, differs remarkably from *Panagaeus* by the head not being constricted into a neck posteriorly, and by the mandibles being thick, dilated, obtuse, and deflexed at the apex.

CYMINDIS Latr.

C. cribrata, nigro-picea, setis brunneis pilosella, capite thoraceque cribratim punctatis, hoc tenuiter marginato convexo, latitudine longiore, postice modice angustato et lateribus parum sinuato, angulis posticis obtusissimis, elytris cyaneo-micantibus, striis foveatim punctatis, interstitiis uniseriatim punctatis, antennis palpis pedibusque ferrugineis. Long. ·36.

Nebraska: one specimen collected by Mr. Burke. Resembles in character *C. pilosa*, but the thorax is longer, and less rounded on the sides anteriorly: the punctures of the striæ of the elytra are less closely placed, and those of the interstices almost form single rows. *C. neglecta* Hald. is smaller, and has the head almost smooth.

ANISODACTYLUS Dej.

A. chalceus, oblongus, elongatus, supra æneus, thorace latitudine vix breviore, punctulato, parce punctato, lateribus postice vix sinuatis, angulis posticis rectis, basi utrinque punctato, profundius impresso, elytris striatis, interstitiis planis alternatim parce punctatis; subtus nigro-æneus, antennis basi rufis; tibiis anticis calcare extrorsum paulo dilatato. Long. ·37.

Santa Fé, Mr. Fendler. Allied to *A. alternans* Lec. (Ann. Lyc. Nat. Hist. 5, 184), but differs in color, and in the less dense punctuation of the alternate spaces between the striæ of the elytra.

HARPALUS Latr.

H. impotens, piceo-niger, oblongus, thorace transverso, lateribus rotundatis, margine angusto reflexo, angulis posticis rotundatis, basi utrinque vage foveato, versus angulos subdepresso, elytris ad marginem subtiliter pubescentibus, striis 2nda, 5ta, 7maque parce punctatis, interstitiis fere planis, epipleuris, ano pedibusque piceis, antennis pedibusque rufo-piceis. Long. ·38.
Lec. Journ. Acad. Nat. Sc. Philad. 2d ser. IV, 14.

One specimen found at El Paso by Dr. Thos. H. Webb. This species is narrower than *Harpalus* (*Selenophorus*) *stigmosus*, and *iripennis*, and is readily distinguished by the rounded angles of the thorax and by the elytral punctures being smaller than in the first mentioned species.

H. oblitus, oblongus, piceo-niger, nitidus, thorace latitudine sesqui breviore lateribus rotundatis, postice subangustato, angulis posticis obtusis; margine piceo postice anguste subexplanato, basi utrinque vage impresso punctulato et rugoso, elytris striis tenuibus, secunda unipunctata; subtus, antennis palpis pedibusque ferrugineis. Long. ·5.

One male, Santa Fé, Mr. Fendler. Resembles *H. compar* Lec. (*pensylvanicus* ‡ Say; *bicolor* ‡ Dej.) in general appearance, but by the thorax being slightly narrowed at base, with only a few small punctures around the basal impressions, it is abundantly distinct. Fully matured specimens will probably be found to have the under surface of the body dark colored.

H. fallax, oblongus, piceo-niger, nitidus, thorace latitudine sesqui breviore lateribus rotundatis, ante medium subangustato, angulis posticis rectis subrotundatis, margine laterali postice subexplanato, cum basi tota punctulato, ad basin utrinque late foveato, elytris striis bene impressis, 2nda unipunctata; antennis, palpis, pedibusque ferrugineis. Long. ·42.

Santa Fé: Messrs. Kern and Fendler. The elytra are slightly sinuate at tip, and those of the female are dull. This species is of the size of *H. herbivagus* Say, but the thorax is distinctly narrowed before the middle, and is much more punc-

tured at base. A very similar nondescript species from New Jersey was kindly given me by Mr. Guex; it differs chiefly by the thorax being broader, with the sides less rounded and less narrowed anteriorly. I have named it *H. viduus*.

H. desertus, oblongus, piceus nitidus, thorace latitudine breviore, lateribus rotundatis vix explanatis, antice posticeque subangustato, angulis posticis subobtusis, subrotundatis, ad basin utrinque punctulato et foveato, elytris ad apicem obtuse rotundatis, striis bene impressis, 2nda unipunctata; antennis palpis pedibusque ferrugineis. Long. ·3.

One immature female: Mr. Fendler. Quite different from any other species known to me, although having somewhat the form of *H. megacephalus* Lec.

H. stupidus, oblongus subovalis, convexus, ater, thorace latitudine plus sesqui breviore, lateribus tenuiter marginatis antice rotundatis, postice subrectis fere parallelis, angulis posticis rectis vix rotundatis, fovea basali utrinque haud profunda, basi tota punctulata, elytris (feminæ subopacis) striis impunctatis, interstitiis vix convexis, apice sinuatis, antennis pedibusque obscure ferrugineis. Long. ·46.

One specimen from route to Fort Bridger: Mr. Drexler. More convex than *H. erythropus*, with the sides of the thorax not flattened, and the posterior angles less obtuse. From these differences in form, this species has somewhat the appearance of *H. funestus* Lec., which however has black feet, and is otherwise quite different.

DICAELUS Bon.

D. laevipennis, oblongo-ovalis, violaceo-niger, thorace antrorsum valde angustato, lateribus rotundatis, elytris tenuiter punctato-striatis, carina humerali ante medium desinente. Long. ·7. Tab. I, fig. I.

Lec. Annals of the Lyceum of Natural History of New York, IV, 421.

Platte River Valley, near Chimney Rock. Very different from all other species yet known, by the striæ of the elytra being indicated only by rows of punctures, which are less obvious towards the apex and sides.

NOMARETUS Lec.

N. cavicollis, æneo-purpureus, nitidus, thorace obovato, postice valde angustato, sulco dorsali profundo, antice disperse punctato, postice latius concavo, profunde impresso et punctato, elytris striis utrinque 12 fortiter crenatis. Long. ·45.

One specimen, Fort Riley: Mr. John Xantus. Resembles *N. fissicollis* and *N. bilobus* (*Cychrus bilobus* Say), but differs from both by the anterior half of the thorax being covered with scattered punctures, and the posterior half being broadly concave; as in those species the posterior angles are obtuse.

CALOSOMA Fabr.

C. luxatum, nigrum subnitidum, capite subtilius punctato-rugoso, thorace capite sesqui latiore, latitudine fere triplo breviore, lateribus valde rotundatis, postice angustiore confertim punctato-rugoso, basi late rotundatim emarginato, utrinque vage impresso, elytris rotundato-ovatis, thorace latioribus, striis tenuibus rugisque transversis imbricatim insculptis, versus apicem confuce rugosis. Long. ·64—·68. Tab. I, fig. 2.

Say, Journ. Acad. Nat. Sc. of Phila. III, 149; (nec. Dej. Sp. Gen. II, 196).

Callisthenes luxatus Lec. Annals of the Lyceum of Nat. Hist. V, 200.

Carabus luxatus Lec. Ann. Lyc. Nat. Hist. IV, 445.

Platte river: on one occasion seen running on the ground in large numbers. Wider and more robust than the other North American species.

C. striatulum, nigrum, capite thoraceque nitidis leviter rugosis, hoc brevi, versus latera et basin rugoso et punctato, postice paulo angustato, ad basin late emarginato, elytris thorace latioribus, subrotundatis, dense striatis, interstitiis imbricatis, versus apicem tuberculis parvis confertis exasperatis. Long. ·65.

Milk river: one specimen found by Dr. Suckley, U. S. A., attached to the North Pacific R. R. Expedition under Gov. J. J. Stevens; Utah, Mr. Drexler. · This species closely resembles *C. Zimmermanni* Lec., which is properly an Oregon species, but differs in the head and thorax being much less punctured; also in the thorax being less narrowed towards the base, and in the striæ of the elytra being more distinct.

Body black; head shining, finely but sparsely wrinkled and punctured, with the frontal impressions moderately deep. Thorax shining, about one-half wider than the head, twice as wide as its length, rounded on the sides anteriorly, obliquely but only moderately narrowed to the base, which is broadly emarginate, with prolonged basal angles; the middle of the base is, however, truncate, and not concave as in *C. luxatum;* the sides are narrowly margined, the dorsal line is distinct; the sides are densely rugosely punctured, but the sculpture becomes indistinct on the disc. The elytra are one-half wider than the thorax, about one-fourth longer than their width, covered with close set striæ, the outer ones of which are indistinct; the interstices are transversely rugose, the rugæ being deeper at the sides and apex, so that the surface is there covered with small rounded tubercles.

ILYBIUS Er.

I. Laramaeus, elongatus ovalis, antice paulo obtusus, nigro-æneus, undique subtiliter dense reticulatus, fere opacus, elytris striola submarginali, maculaque majuscula anteapicali pallidis, ore pedibusque anterioribus piceo-rufis, pedibus posticis nigro-piceis. Long. ·37—·41.

Fort Laramie: narrower and less convex than our species found in the Atlantic States, with the sides of the thorax less rapidly converging in front: resembling more nearly in form the *I. 4-maculatus* of Oregon; it is, however, less oval than that species, with the sides less rounded, and the anteapical spot larger. The specific differences in this genus are very unsatisfactory, and depend entirely upon slight modifications in form, which cannot be clearly expressed in a description.

AGABUS Leach.

A. clavatus, elongato-ovalis, modice convexus, piceus nitidus, obsolete punctulatus, capite, thoracis elytrorumque lateribus sensim rufo-piceis, pedibus antennisque ferrugineis, his articulis externis dilatatis, 9–11 nigro-piceis. Long. ·34.

Three males from Loup Fork of the Platte: Dr. Hayden. A most interesting addition to our fauna, being the analogue of *A. serricornis* of Europe. The 5th, 6th, and 7th joints of the antennæ are gradually wider; the 8th, 9th, and 10th are subrectangular, wider than long, and as wide as the 7th; the 11th is oval and pointed, narrower than the 10th.

A. griseipennis, elongato-ovalis, parum convexus, æneo-niger, supra dense (feminæ fortiter) reticulatus, elytris luteo-griseis base margineque pallidioribus, antennis palpisque flavis, pedibus ferrugineis, femoribus nigro-maculatis; thorace cum elytris angulum haud formante. Long. ·36.

Fort Laramie, one female. Differs from the species of somewhat similar color inhabiting the United States by its more elongate form, gradually tapering both before and behind; the thorax continues accurately the outline of the elytra. The reticulations are very dense, and somewhat longitudinal, especially at the base of the elytra. The Californian *A. lutosus* Lec. approaches it very closely, and it may in fact prove to be the other sex of that species, of which I possess at present only males. The form is, however, somewhat narrower.

A. obliteratus, ovalis, elongatus parum convexus, æneo-niger, nitidus supra subtilissime, vix conspicue reticulatus, elytris luteo-piceis, marginibus pallidioribus, seriebus punctorum solitis valde distinctis, ad basin thorace paulo latioribus, antennis palpis tibiis tarsisque anterioribus ferrugineis. Long. ·32.

Fort Laramie, three specimens. The sculpture of the female is hardly more conspicuous than that of the male. It is sufficiently distinguished from our other species by the characters above given.

A. spilotus, ovalis, æneo-niger nitidus, parum convexus, vix subtilissime reticulatus, thorace cum elytris angulum haud formante, elytris seriebus solitis distinctis, lineola utrinque submarginali, guttaque subapicali pallidis, antennis palpisque rufis, tarsis anterioribus rufo-piceis. Long. ·35.

Two females, Fort Laramie. Resembles *A. obtusatus,* but is less dilated, and differs very much by the reticulation being so minute as to be scarcely visible even with a high magnifier. The spots are not very obvious.

ANISOMERA Brulle.

A. cordata, supra æneo-picea, elongato-ovalis depressa, subtilissime reticulata, thorace brevi, postice angustato et lateribus sinuato, elytris thorace vix latioribus, postice non dilatatis; subtus nigra, ore antennis pedibusque rubro-piceis. Long. ·45. Tab. II, fig. 3.

Lec. Proc. Acad. Nat. Sc. VI, 226.

Santa Fé; Mr. Fendler. Varies in having black feet; the sides of the thorax are strongly rounded in front, and subsinuate behind; the base is as wide as the apex, the anterior dilatation being produced by the curvature of the sides; the anterior angles are acute, the posterior ones rectangular. The elytra are very little wider than the thorax, regularly elongate elliptical, with the usual series of punctures becoming irregular towards the tip.

By comparing the figure here given with the South American *A. bistriata* Brullé (figured in Dejean's Icon. Col. Europe, V, tab. 23, fig. 5), it will be seen that they correspond very closely. The middle lobe of the mentum of our species is broad, short, and very obsoletely sinuate; in the generic description given by Aubé, the mentum of *A. bistriata* is said to have the middle lobe slightly prominent in the middle. This character needs confirmation, as it is hardly possible that two species so closely related should differ in this particular. Though distinct in form, this genus is separated from Agabus by very trifling differences.

SILPHA Linn.

S. bituberosa, ovalis depressa, nigra opaca, dense punctata, thorace latitudine plus duplo breviore, lateribus anguste marginatis valde rotundatis late planatis, postice utriuque late oblique impresso, elytris fortiter marginatis, apice conjunctim rotundatis, costis tribus postice paulo abbreviatis, internis duabus parum distinctis, externa tuberculum posticum transeunte. Long. ·5.

One specimen found near Fort Bridger, Mr. Drexler; belongs to the division of the genus having the 8th—11th joints of the antennæ about one-half wider than those which precede; the 8th to 10th are not much wider than long; the 2d is quite as long as the 3d.

S. truncata, oblonga, atra subopaca, capite thoraceque dense aciculato-punctatis, hoc antrorsum valde angustato, ad basin trisinuato, postice utrinque versus latera oblique impresso, elytris lateribus fortius marginatis, subtilius punctatis, ad dodrantem callo discoideo parum distincto utrinque notatis, ad apicem late truncatis; antennarum articulo 3io vix longiore. Long. ·5—·67. Tab. I, fig. 3.

Say, Journ. Acad. Nat. Sc. III, 193. Lec. Proc. Acad. Nat. Sc. VI, 278.

Platte river, near the Forks. A very distinct species; the specimen figured is a male: the abdomen of the female projects far beyond the elytra.

CARPOPHILUS Leach.

C. apicalis, oblongus, piceo-niger, minus subtiliter punctatus et flavo-pubescens, thorace modice convexo, latitudine haud sesqui breviore, lateribus marginatis rotundatis, elytris thorace sesqui longioribus, rufis, circa scutellum et ad apicem extrorsum oblique infuscatis, pedibus antennisque testaceis. Long. ·1.

Platte river: found also in Georgia; narrower and more convex than is usual in this genus.

C. carbonatus, oblongus subdepressus, piceo-niger, parcius pubescens et punctatus, thorace latitudine plus sesqui breviore angulis omnibus rotundatis, ad apicem vix emarginato, lateribus late rotundatis tenuiter marginatis, elytris alutaceis obsoletius punctulatis, thorace duplo longioribus, antennis basi piceis. Long. ·1.

Found on the Platte river and at Lake Superior.

MELIGETHES Kirby.

M. ruficornis, oblongus subconvexus, nigro-viridis, dense subtiliter punctatus, breviter cinereo-pubescens, thorace antrorsum angustato, lateribus rotundatis anguste marginatis, pone medium subfoveatis, angulis posticis subrectis, antennis tarsis tibiisque rufis, his anticis subtiliter serratis, posterioribus latioribus ultra medium et ad apicem ciliatis; unguibus simplicibus, prosterno postice anguste rotundato. Long. ·11.

Platte river, not rare. Differs by obvious characters from all European species thus far described, and were it not that the prosternum is rounded posteriorly, it would enter Erichson's division B, (Ins. Deutschl. 173.)

M. sævus, oblongus subconvexus, niger, dense subtiliter punctatus, breviter cinereo-pubescens, thorace antrorsum angustato, lateribus rotundatis anguste marginatis, angulis posticis rotundatis, margine basali undulato, antennis basi piceis; tibiis anticis 5-dentatis ad basin serratis, intermediis extrorsum emarginatis et posticis dense spinulosis; unguibus simplicibus, prosterno postice late rotundato. Long. ·11.

One specimen; Platte river; belongs to Erichson's division C, (loc. cit. 179.)

HISTER Linn.

H. instratus, quadrato-ovalis, niger nitidus, thorace bistriato, lateribus dense flavo-ciliatis, elytris stria suturali utrinque abbreviata, tribus externis integris, marginali brevissima, rudimentalique ad basin interna notatis, macula utrinque lunata maxima rubra ornatis; tibiis anticis bidentatis, posticis compressis biseriatim spinulosis, femoribus posticis majoribus rubro-tinctis. Long. ·24—·32.

Platte river: Intermediate between *H. arcuatus* Say, and *H. biplagiatus* Lec., having the elytral spot and compressed posterior tibiæ as in the latter, while by the very densely ciliate margin of the thorax, the thick and sometimes reddish posterior thighs, and the more numerous spines of the posterior tibiæ it is evidently related to the former. The outer series of spines is composed of numerous spines placed irregularly in nearly a double row, while in *H. biplagiatus*, they are distant and regular; the posterior tibiæ are slightly less compressed than in that species.

H. nubilus, rotundato-ovalis, niger, nitidus, thorace bistriato, stria externa margini approximata, ante medium abbreviata, elytris striis externis 4 integris, 5ta postica brevi, suturali ante medium antice abbreviata, epipleuris striis duabus punctatis, striolaque brevi inferna; mesosterno fere truncato; pygidio sat dense punctato, tibiis anticis sub-5-dentatis. Long. ·25.

One specimen: Platte river. This and the next are very distinct from any of our other species, in which the mesosternum is not distinctly emarginate, and the elytral marginal striæ wanting.

H. pollutus, rotundato-ovalis, niger nitidus, thorace bistriato, stria externa margine approximata ante basin abbreviata, elytris striis externis 3 integris, 4ta ad medium postice abbreviata, 5ta obsoleta, suturali utrinque parum abbreviata, epipleuris 3-striatis; mesosterno fere truncato; pygidio parcius punctato, tibiis anticis sub-4-dentatis. Long. ·20.

Kansas and New Mexico.

SAPRINUS Leach.

S. spurcus, quadrato-rotundatus, æneo-niger, nitidus, capite punctulato, thorace lateribus dense punctatis, antice vix obsolete impresso, margine laterali sublævi, elytris striis dorsalibus æqualibus ad medium abbreviatis, interna cum suturali integra connexa, marginali brevi obliqua cum humerali fere juncta; punctatis postice subaciculatis, spatio scutellari quadrato, margineque laterali lævibus, epipleuris bistriatis punctatis, tibiis anticis sub-6-dentatis. Long. ·14.

One specimen: Platte river. Belongs to my division 4 (Proceedings Acad. Nat. Sc. Phila. VI, 40), having the head not margined in front, the epipleuræ bistriate, the prosternum transversely convex, with an anterior fovea on each side, and the prosternal striæ parallel, abbreviated in front. It is closely related to *S. lugens*, but is very considerably smaller, with the punctures of the elytra less aciculate, the thorax scarcely impressed, and with the punctures of the sides not extending to the lateral margin, which is only punctulate.

S. parumpunctatus, rotundatus, nigro-æneus nitidus, parce punctulatus, thorace lateribus et basi confertim punctato, antice haud impresso, elytris striis paulo pone medium abbreviatis, æqualibus, 4ta cum suturali integra conjuncta, marginali brevi, postice haud dense punctato, pedibus rufis, tibiis anticis denticulatis. Long. ·13.

One specimen: Platte river. Resembles *S. conformis*, and *placidus*, but differs, besides slighter characters above mentioned, by the punctures of the posterior

portion of the elytra being smaller and less deep. Belongs to my group 6, having the prosternum transversely convex, foveate each side in front, with the striæ remote and divergent; the head not margined in front, and the epipleuræ bistriate.

S. pratensis, rotundatus, nigro-æneus, vel nigro-cupreus, nitidus, thorace lateribus et basi confertim punctato, antice haud impresso, elytris striis ad medium abbreviatis æqualibus, 4ta cum suturali conjuncta, marginali brevi, dimidio postico dense punctatis, extrorsum fere aciculatis, punctis inter striam humeralem et 2ndam ad basin, extensis; pygidio dense punctato, pedibus rufis, tibiis anticis denticulatis. Long. ·13—·20.

Platte river, and Fort Riley, abundant. I was inclined to believe this to be *S. orbiculatus* Marseul found in Texas, but the punctures extending to the base are not entirely outside of the dorsal striæ, but occupy also the spaces as far as the 2d stria; these spaces are sometimes also slightly rugous. The prosternum is subcarinate, margined with the striæ divergent; it therefore belongs to my division 7, (Proc. Acad. VI, 40.)

PHILEURUS Latr.

P. valgus. (Tab. II, fig. 4.)

On comparing specimens from Georgia, Missouri, Texas, and New Mexico, forming *P. castaneus* Hald., with one from Brazil in the collection of the Academy of Natural Sciences, I can perceive no difference whatever. Burmeister has observed that the species extends its range from South America into Mexico, but adds that he has not seen specimens from the regions north of that country. Individuals occur of a dark brown color, but I suspect these to be immature: the usual color is a full black.

POLYPHYLLA Harris.

P. decemlineata, picea, dense luteo-squamosa, clypeo maris valde concavo, antice latiore recte truncato (feminæ lateribus parallelis apice sinuato), capitis lateribus albopilosis; thoracis canaliculati vittis tribus, scutello medio, elytrorum sutura vittis utrinque tribus humeralique brevi cum externa confluente niveo-squamosis; subtus niveo-squamosa, pectoribus longe luteo-villosis, pedibus ferrugineis parcius squamosis (tibiis anticis maris bidentatis, feminæ tridentatis). Long. 1·0—1·4. Tab. I, fig. 6, (*a*, tib. ant. feminæ.)

Lec., Proc. Acad. Nat. Sc. VII, 218; Journ. Acad. Nat. Sc., 2d ser. III, 230.
Melolontha 10-*lineata* Say, Journ. Acad. Nat. Sc. III.

Kansas, New Mexico, Texas, California, Oregon. The thorax has occasionally a round whitish spot near each side.

THYCE Lec.

T. squamicollis, ferrugineo-picea, capite thoraceque confertissime punctatis, pilis depressis squamiformibus pallidis obsitis, elytris nitidis punctatis et rugosis, brevissime parce pubescentibus, pygidio abdomineque squamulosis, pectore valde lanuginoso. Long. 1·03. Tab. II, fig. 5.

Lec. Journ. Acad. Nat. Sc. 2d ser. III, 232.

One female found at Albuquerque, by Dr. T. Charlton Henry, U. S. A. Reddish brown above and beneath; head densely punctured, front nearly straight anteriorly, with the margin broadly reflexed, covered with small pale yellowish scales. Thorax convex, narrowed in front, much rounded and subserrate on the sides, broadly but feebly channelled in the middle, vaguely impressed each side near the anterior angles

which are acute; densely punctured, covered thinly with yellowish scales like those on the head; scutel densely pubescent with a medial glabrous line. Elytra shining, not densely punctured, with rugæ as in most of the species of *Phyllophaga;* each puncture furnished with a pale short hair. Pygidium densely, abdomen sparsely covered with small pale scales. Pectus with dense long yellow hair. Anterior tibiæ three-toothed; middle and posterior tibiæ with two sharp teeth near the middle.

LACHNOSTERNA Hope.

L. lanceolata, picea (mas oblonga, femina crassa), supra squamulis lutescentibus dense tecta haud punctata, clypeo reflexo vix emarginato, thorace lateribus antice valde rotundatis, angulis posticis rectis, linea dorsali subglabra, elytris vittis utrinque tribus indistinctis subglabris; subtus dense sordide pubescens, antennis pedibusque obscure ferrugineis. Long. ·53—·68. Tab. I, fig. 5(♀).

Lec. Journ. Acad. Nat. Sc. 2d ser. III, 237.

Melolontha lanceolata Say, Journ. Acad. Nat. Sci. III, 242.

Tostegoptera lanceolata Blanch. Cat. Col. Mus. Paris, 149; Burm. Lamell. II, 2d, 356.

Ancylonycha lanceolata Lacordaire, Gen. Coleopt.. III, 285.

Throughout Kansas, extending into Eastern New Mexico and Upper Texas. The male is winged, while the female is apterous. The genus *Tostegoptera*, as very properly observed by Lacordaire (Gen. Col. III), does not differ from Lachnosterna by any essential characters.

DIPLOTAXIS Kirby.

D. obscura, oblonga nigro-picea, subnitida, capite hemihexagono, dense punctato, antice late emarginato, margine anguste reflexo, sutura frontali profunda, vertice late bifoveato, thorace brevi dense punctato, medio paulo latiore, lateribus rotundatis, angulis anticis subacutis, posticis subrectis, margine laterali reflexo, ad angulos latiore impresso, elytris punctatis, tricostatis, tibiis anticis tridentatis. Long. ·45.

One specimen from the Black Hills: Dr. Hammond. Resembles somewhat *D. brevicollis* Lec., but is more densely punctured, with the sides of the thorax more rounded, and more deeply impressed at the angles: the two foveæ of the vertex, if a constant character, will serve easily to distinguish it.

DIAZUS Lec.

Corpus oblongum alatum, breviter pubescens; caput mediocre, clypeo marginato, hemihexagono, sutura frontali parum distincta; labrum transversum late emarginatum; palpi maxillares articulo ultimo elongato-ovali, acuto haud impresso; mandibulæ vix prominulæ obtusæ; mentum quadratum antice concavum; antennæ breves, 9-articulatæ, clava parva triphylla. Tibiæ anticæ unicalcaratæ, 3-dentatæ; posteriores paulo incrassatæ, obsolete bicoronatæ, calcaribus parvis; tarsi antici tibiis haud longiores, intermedii tibiis paulo longiores, postici tibiis breviores, crassinsculi; articulis omnium 4 primis æqualibus, 5to paulo longiore, unguiculis haud dentatis. Thorax linea apicali nulla, margine membraneo distincto.

A genus belonging to the *Diplotaxes*, and having the characteristic form of abdomen of that tribe, viz., the 5th ventral segment united without suture to the propygidium, with the spiracle each side midway between the anterior and posterior margin. It differs, nevertheless, remarkably from the other genera by the nine-

jointed antennæ and simple ungues. The rough sculpture and short sparse pubescence give the insect very much the appearance of an *Ochodæus*.

D. rudis, ferrugineo-fuscus, oblongus, parum nitidus, pilis brevibus minus subtilibus, albidis minus dense vestitus, capite punctato, hemihexagono, clypeo antice latius emarginato, thoracc convexo antrorsum angustato, lateribus valde rotundatis, dense punctato, elytris rugose punctatis, sutura costisque solitis tribus parum elevatis, pygidio confertim punctato. Long. ·30.

Two specimens from the black hills: Dr. W. A. Hammond. The punctures are large and not deep. The body beneath is more shining, and less densely punctured.

OMORGUS Er.

O. scutellaris, apterus, niger, thoracc cataphracto valde inæquali, lateribus rotundatis, elytris seriatim minus distincte punctatis, transversim cælatis, interstitiis subquadratis, subæqualiter parum elevatis. Long. ·6—·65. Tab. I, fig. 4.

Lec. Proc. Acad. Nat. Sc. VII, 214.

Trox scutellaris Say, Journ. Acad. Nat. Sc. III, 238.

From Platte river to Santa Fé. Other nearly allied species found in Texas are described by me in the place above cited; from all of them, however, it may be distinguished by the assemblage of characters here given.

CANTHON Illiger.

C. praticola, subovatus, ater opacus, supra subtilius licet evidenter granulatus, clypeo 6-dentato, dentibus duobus mediis obtusis, reliquis latis modice prominulis, thoracc brevi convexo, lateribus valde rotundatis, elytris capite thoraceque vix longioribus, basi late emarginatis, lateribus et apice rotundatis, planiusculis versus scutellum paulo impressis, striis parum distinctis; thoracc subtus versus angulum anticum tuberculo minuto marginali instructo, pro receptione pedum parum excavato, pygidio convexiusculo, parce subtiliter granulato. Long. ·27—·37.

Kansas and New Mexico. Resembles *C. nigricornis*, but the form is less abbreviated, the lateral teeth of the clypeus are more prominent, the elytra are less sparsely granulate, and the pygidium is more finely granulate, not impressed or carinate towards the base.

For the purpose of enabling the relations between the species of *Canthon* inhabiting the United States to be understood, as well as of providing names for several nondescript species, I add the following synoptic table:—

A. Prothorax pleuris linea transversa a coxis procedente obsoleta vel nulla.

a. Prothorax pleuris margine versus angulum anticum tuberculo minuto subinterrupto.

* Clypeo rotundato, bidentato; (species magnæ).

rotundatus supra granulatus, oculis latiusculis	*vigilans.*
rotundatus, oculis angustissimis;	
supra evidenter granulatus	*lævis.*
obsolete granulatus	*chalcites.*

** Clypeo 6-dentato; (species minores).

§ Pygidio rude granulato, basi plus minus carinato;

clypei dentibus omnibus magnis;	
oblongo-rotundatus, supra rude granulatus	*ebenus.*
rotundatus, supra subtilius granulatus	*depressipennis.*
clypei dentibus lateralibus minus prominulis;	
breviter rotundatus, supra subtiliter, elytris parcius granulatus	*nigricornis.*

§§ Pygidio vix granulato, haud carinato;
ovato-rotundatus, supra granulatus — *praticola.*
rotundatus, supra haud granulatus — *abrasus.*
b. Prothorax pleuris margine versus angulum anticum tuberculo nullo (pro receptione pedum parum concavis).
* Clypeo 6-dentato, dentibus externis parum prominulis;
rotundatus, ater, granulis depressis parcis obsitus — *simplex.*
** Clypeo 4-dentato, dentibus internis acutis;
rotundatus, nitidus, nigro-cyaneus, punctulatus — *cyanellus.*
B. Prothorax pleuris linea transversa a coxis procedente notatis, antice pro receptione pedum subito declivibus; (clypeus dentibus internis obtusis reliquis obsoletis).
thorace punctato, elytris subopacis (cupreus, vel viridis) — *viridis.*
thorace fortius punctato, elytris nitidis punctulatis — *perplexus.*

The species in the above synopsis, not before mentioned, are:—

C. depressipennis. A black, or greenish black species found in Georgia, resembling very closely *C. ebenus*, and only differing from that species by the body being less oblong, the thorax less suddenly rounded on the sides, and the granulations of the upper surface more minute. Long. ·30—·35.

C. abrasus. A small rounded dull black species, from Georgia, with the eyes broader than usual, having no visible sculpture on the head and thorax, and very feebly granulate on the elytra, which are depressed in the scutellar region: the striæ are very indistinct, the pygidium not granulate. Long. ·24.

C. cyanellus. A shining, very dark blue rounded species found in Texas, and given me by Mr. Ulke, having the clypeus oblique on the sides, and 4-dentate in front, the middle teeth being narrower than in the other species; the thorax is very minutely punctulate, much rounded and almost angulated on the sides, with a fovea remote from the margin opposite the widest part; the elytra are feebly punctulate, obsoletely striate, impressed at the scutellar region. Pygidium dull, obsoletely punctulate. Margin of the prothorax beneath without the small tubercle usually seen near the anterior angle. Long. ·37.

Synonyms to be observed are:—

C. lævis: *Scarabæus lævis* Drury, Oliv.; *Scarabæus volvens* Fabr.; *Ateuchus volvens* Fabr.; *Scarabæus pilularius* ‡ De Geer. *Coprobius obtusidens* Ziegler, is a slight variety of this species.

C. viridis: *Copris viridis* Beauv.; *Onthophagus viridicatus* Say. *Ateuchus obsoletus* Say, is a copper-colored variety of this species, which is more frequently found on leaves than in any other situation. Chevrolat (Ann. Ent. Soc. France, 2d ser. X, 632) refers Beauvois' species to *Onthophagus*, but I do not see anything in the figure or description to warrant such a reference.

Ateuchus probus Germ., Ins. Nov. 98, probably belongs to this genus, but I do not know any species that agrees with the description.

MELANOPHILA Esch.

M. miranda, nigra, ænescens, subtiliter dense punctulata, capite guttis quinque politis, circulo positis, thorace guttis quatuor anticis (intermediis maioribus), altera utrinque pone medium, lineaque dorsali postica nitidis lævigatis; elytris margine basique tenuiter rubris, lineisque flavis decussatis ornatis. Long. ·65. Tab. II, fig. 7.

Lec. Trans. Am. Phil. Soc. XI, 212.
Phœnops mirandus Lec. Proc. Acad. Nat. Sc. VII, 83.

One specimen found at Fort Union, by Major Sibley. This is the most elegant species of the genus, the name of which seems by no means appropriate, yet being older than that of *Phœnops* must be retained.

CHRYSOBOTHRIS Esch.

C. quadrilineata, fusco-ænea, punctata opaca, latiuscula, capite pubescente, thorace lineis quatuor elevatis nitidis, medio valde canaliculato, elytris utrinque lineis elevatis nitidis, marginali suturalique integris, hac antice latiore, intermediis duabus confluentibus et pone medium interruptis. Long. ·48—·60.
Lec. Trans. Am. Phil. Soc. XI, 233.

Santa Fé: Mr. Fendler. Broader and more robust than the other species found in the United States, and easily known by the sculpture of the thorax. The latter is twice as wide as its length, very deeply channelled in the middle, with a broad shining sparsely punctured entire vitta each side of the channel, and another each side which does not reach the apex; the depressed portions are opaque and very densely punctured. The elytra are wider than the thorax, serrate at the sides and apex, with an entire elevated shining line near the suture, dilated anteriorly so as to reach the suture, and an entire slender elevated line parallel with the outer margin; between these are two elevated lines which are confluent in two places, and interrupted behind the middle; the base is very deeply foveate as usual: the depressed portions are all densely punctured, and without lustre. Body beneath coarsely punctured, prosternum flat, covered with long white hair, with a slightly elevated smooth medial line.

C. cuprascens, obscure cupreo-ænea, longiuscula, minus depressa, fronte viridiæneo, dense punctato pubescente, thorace irregulariter punctato, vage impresso et subcanaliculato, elytris confertim punctatis, utrinque biimpressis, lineis nitidis elevatis, suturali marginalique integris, discoidali interna bis interrupta, externa ad medium postice abbreviata. Long. ·31.
Lec. Trans. Am. Phil. Soc. XI, 234.

One specimen: Mr. Fendler. Resembles some of our smaller species, but is more convex and more coppery. The posterior impression of the elytra is deeper and larger than the anterior one, and although slightly lobed is not sinuous; the elevated lines are nearly smooth. The anterior tibiæ of the male are slightly bent, and armed with a tooth internally near the tip.

PSILOPTERA Solier.

P. Woodhousei, ænea, nitida, chalybeo-variegata, thorace confertim punctato, brevi, lateribus valde rotundatis, antrorsum angustato, angulis posticis rectis, elytris apice integris, seriatim crenatis, maculis irregularibus opacis transversis profunde impressis. Long. ·72—·97. Tab. II, fig. 6.
Lec. Trans. Am. Phil. Soc. XI, 195.
Dicerca? Woodhousei Lec. Proc. Acad. Nat. Sc. VI, 68.
Var. major, *Psiloptera valens* Lec. Proc. Acad. Nat. Sc., 1858, 66.

Creek Boundary Expedition: Dr. S. W. Woodhouse; Texas, Mr. Schott.

Body coppery bronze, varied with bluish reflections, moderately stout and convex; head strongly punctured, with three faint confluent elevated lines on the front;

labrum green; thorax cribrate punctate, more than twice as wide as broad as long, narrowed in front, very strongly rounded on the sides, narrowed a little towards the posterior angles, which are rectangular and sharp. Elytra with rows of large punctures, and with numerous deep impressed subconfluent spaces, which are opaque, densely punctured and finely pubescent; tip entire. Legs green bronzed, knees, tip of the tibiæ, and tarsi steel blue. Tip of the abdomen very slightly truncate in the male, rounded in the female.

CHAULIOGNATHUS Hentz.

C. basalis, elongatus niger, thorace fulvo nitido, subrotundato, marginato, disco plus minus nigro, elytris rugose punctatis, flavo-fulvis macula magna communi triangulari basali, tricnteque postico nigris, abdomine flavo, sæpe nigro annulato, articulo ultimo nigro. Long. ·42.

Abundant near Fort Bridger and in the Black Hills: Dr. Hammond, Mr. Drexler. Varies much in the size of the black spot of the thorax, which is sometimes emarginate, and sometimes even divided into four dots. The antennæ of the male are as long as the body, of the female two-thirds as long. The thorax in *C. limbicollis* and *scutellaris* is opaque, while in the present it is very smooth and shining.

NIPTUS Boieldieu.

N. ventriculus, rufo-piceus, nitidus, pube sordida minus subtili dense vestitus, thorace globoso, grosse punctato, postice valde coarctato, tuberculis parum elevatis quatuor transversim positis, e pilis efformatis; elytris ovalibus, ventricosis, seriatim punctatis, setis erectis sat dense hispidis. Long. ·10.

Santa Fé: Mr. Fendler. The elytra are twice as wide as the thorax, and about one-half longer than wide; the punctures are tolerably large and distant, and become smaller on the declivous posterior portion. The second joint of the antennæ is as long as the third.

TRYPOPITYS Redt.

T. punctatus, elongatus, fuscus sericeo-pubescens, thorace ad basin utrinque transversim excavato, et in medio breviter carinato, elytris striis e punctis digestis vix impressis. Long. ·25.

One specimen: Mr. Fendler. Precisely resembles in appearance *T. sericeus*, (*Xyletinus sericeus* Say, Journ. Acad. Nat. Sc. V, 171), but the thorax is less deeply excavated at base, and the striæ instead of being deep and cribrate are hardly impressed, and the interstices are flat.

PACTOSTOMA Lec.

P. anastomosis, piceus, pilis sordidis setiformibus parce vestitus, thorace punctato, subcanaliculato, latitudine breviore lateribus rotundatis marginatis, basi subtruncato, angulis posticis obtusis, elytris ovalibus postice subacutis et declivibus, parce punctatis, sutura, margine costisque tribus acute elevatis, quarum prima recta, secunda et marginali flexis cum prima confluentibus, tertia irregulari utrinque valde abbreviata. Long. ·42—·5. Tab. II, fig. 11.

Lec. Journ. Acad. Nat. Sc. 2d Ser. IV, 19.

Microschatia anastomosis Lec. Proc. Acad. Nat. Sc. VI, 446.

Asida anastomosis Say, Journ. Acad. Nat. Sc. 3.

Pelecyphorus anastomosis Lec. Ann. Lyc. Nat. Hist. V, 129.

Ologlyptus anastomosis Lac. Gen. Col. V, 159.

Kansas and New Mexico, near the Rocky mountains. The first dorsal costa is nearly straight, and extends from the base to the apex; the second commences near the base, and being curved, unites with the first about one-third from the tip; the third is irregular, running from the anterior third to the posterior fourth; the marginal one is entire, and unites with the first near the tip.

ASIDA Latr.

A. opaca, oblonga atra, opaca, brevissime parce flavo-pubescens, capite thoraceque scabro-punctatis, illo antice transversim excavato, hoc antrorsum angustato, latitudine breviore, lateribus rotundatis late subdepressis postice subsinuatis, angulis omnibus acutis, posticis paulo productis, elytris parce subtiliter minus profunde punctatis vage inæqualibus, nonnunquam obsolete sulcatis, lateribus margiuatis, humeris obtusis. Long. ·5—·68. Tab. I, fig. 9.

Say, Journ. Acad. Nat. Sc. III, 254.

Euschides opaca Lec. Annals of the Lyceum of Nat. Hist. V, 127.

Kansas and New Mexico, near the mountains: specimens from the latter locality are smaller, and have the elytra much more uneven than those found near Platte river, but do not appear sufficiently distinct to be considered as another species.

EUSCHIDES Lec.

E. convexa, nigra subnitida, capite punctato antice transversim sulcato, thorace latitudine sesqui breviore, subtiliter parce punctato, lateribus rotundatis, margine punctato anguste reflexo, angulis anticis acutis, posticis obtusis haud rotundatis, elytris transversim convexis, pone basin thorace paulo latioribus, ad apicem valde declivibus, subtiliter rugosis lineis tribus obsoletis utrinque notatis, humeris marginatis prominulis. Long. ·85. Tab. I, fig. 10.

Arkansas river, near the mountains. Nearly allied to *Eu. obovata* Lec.; but with the thorax more convex and less broadly margined, and the elytra less obovate and more convex transversely. From *Eu. convexicollis* Lec. it differs by the larger and more strongly margined thorax.

PELECYPHORUS Solier.

P. sordidus, piceo-niger, capite modice transversim impresso, punctato, thorace latitudine fere sesqui breviore ante medium angustato, lateribus rotundatis subserratis deplanatis et subreflexis, confertim grosse inæqualiter punctato, elytris oblongo-ovalibus, convexis postice subacutis, sutura margine costisque utrinque duabus elevatis, lineis transversis sinuatis inter se irregulariter connexis; prosterno postice late sulcato. Long. ·75—·85. Tab. I, fig. 11(♀).

Lec. Proc. Acad. Nat. Sc. VI, 446.

Arkansas river, near the mountains: also found in New Mexico, by Dr. Webb, of the Mexican Boundary Commission. In the female, the elytra are twice as wide as the thorax, and more rounded on the sides than in the male. The specimens are covered with a yellowish earthy substance which adheres closely.

EUSATTUS Lec.

E. reticulatus, rotundatus convexus, ater opacus, thorace obsoletissime punctulato, lateribus marginatis paulo reflexis, angulis posticis valde productis, elytris foveis quadratis vagis impressis, obsolete sulcatis, tibiis anticis extrorsum serrulatis, versus apicem lævibus. Long. ·46—·53. Tab. 1, fig. 7 (*a*, tibia antica).

Lec. Ann. Lyc. of Nat. Hist. V, 132.

Zophosis reticulata Say, Journ. Acad. Nat. Sc. III, 250.

Found near the Rocky mountains from Platte river to Santa Fé, and westward as far as Tucson. Larger than *E. convexus* Lec., and less convex; the sides of the thorax are not suddenly depressed behind the middle as in that species.

EMBAPHION Say.

E. contusum, atrum opacum, thorace latitudine fere duplo latiore, antice profunde emarginato, lateribus valde rotundatis, disco parce punctato, parum convexo, margine late explanato modice reflexo, angulis anticis subacutis, posticis latis obtusis valde rotundatis, ad basin medio recte truncato, elytris dorso planis, postice valde declivibus et acute angustatis, thorace vix latioribus, fortiter reflexo-marginatis, seriatim subtilius sat dense muricato punctatis, ad apicem singulatim breviter acuminatis (♀), vel in cauda brevi prolongatis ( ). Long. ·55—·65. Tab. I, fig. 8.

Lec. Journ. Acad. Nat. Sc., Philad., 2d ser. IV, 40.

Fort Laramie and Santa Fé. Though differing very much in form from the Helæus like *E. muricatum* Say, the forms of the antennæ, oral organs and legs require it to be associated with that species. The figure given saves the necessity of a long description, while the diagnosis above will enable the species to be readily recognized.

Two specimens found by Dr. Webb, near the Mexican boundary, differ in having the sides of the thorax much more strongly reflexed, so that that part becomes much narrower than the elytra. This is, probably, merely a local variety, as similar differences occur among individuals of *Cychrus elevatus*, and in many other insects which have the margins of the body widely reflexed.

BLAPSTINUS Latr.

B. pratensis, elongato-ovalis convexus, ater opacus, breviter subtiliter fusco-pubescens, capite thoraceque punctatissimis, hoc latitudine sesqui breviore, lateribus late rotundatis, ad apicem emarginato, angulis anticis acutis ad basin sinuato, angulis posticis rectis, elytris striis fortius punctatis, interstitiis paulo convexis, punctulatis. Long. ·20—·23.

Platte River Valley, abundant. Differs from the Californian *B. pubescens* Lec., by the finer pubescence, by the more widely rounded sides of the thorax, and by the more prominent anterior angles.

B. vestitus, elongato-ovalis, convexus, æneo-niger, pube albida minus subtili dense vestitus, capite thoraceque confertim punctatis, hoc latitudine vix breviore, antrorsum paulo angustato, lateribus late rotundatis, ad apicem emarginato, angulis anticis acutis, ad basin sinuato, angulis posticis rectis, elytris striis punctatis, interstitiis planis punctulatis. Long. ·20.

Two specimens from Platte River Valley. Very closely allied to the preceding, but the coarse pubescence, and the flattened intervals of the elytra seem to be sufficient characters for separating it.

CENTRONOPUS Solier.

C. opacus, elongatus, niger opacus, capite postice punctato, fovea verticali notato, antice concavo, epistomate late rotundato et fortiter marginato, thorace quadrato, antice vix angustiore, lateribus parum rotundatis, angulis posticis acutis, parum convexo, parce punctato, elytris striis e punctis parvis constitutis. Long. ·57.

One male; Black Hills, Dr. Hammond. Differs from the Mexican *C. suppressus*, according to description, by being opaque, with finer elytral striæ. The sexual

characters are nearly as in that species; the anterior femora have on the anterior face near the base an oval patch of yellow hair; the tibiæ are dilated internally at the middle into an obtuse angle, then broadly emarginate to the tip, at the inner side of which is a dense short brush of yellow hair; the first three joints of the anterior and middle tarsi are dilated, and furnished beneath with a dense brush of yellow hair; the middle tibiæ are thick internally at the apex and have also a brush of hair.

XYSTROPUS Solier.

X. pinguis, ater opacus, subtilissime punctulatus, brevissime pubescens, thorace brevi, lateribus valde rotundatis, basi sinuato, angulis posticis haud prolongatis, elytris striatis, interstitiis paulo convexis. Long. ·37.

Santa Fé, Mr. Fendler: one specimen. Resembles *X. brevis* (*Cistela brevis* Say), but differs in the antennæ and feet being entirely black. The thorax is less deeply sinuate at the base, and the posterior angles are less acute, and not prolonged.

CYSTEODEMUS Lec.

C. vittatus, niger, capite thoraceque opacis, vage grosse punctatis, illo ad basin fere truncato, hoc subquadrato, subtiliter canaliculato, ad basin valde emarginato, elytris brevibus, inflatis obtusis, cribrato-punctatis, vitta angusta rubra abbreviata ornatis, abdomine amplissimo lævigato. Long. ·5—·7. Tab. II, fig. 9.

Lec. Proc. Acad. Nat. Sc. VI, 330.

New Mexico, Dr. Wislizenus: found on the journey from Santa Fé to Chihuahua.

C. wislizeni, cyanescens, nitidus, capite thoraceque grosse punctatis, illo postice rotundato, hoc pentagono, canaliculato, angulis lateralibus acutis, elytris splendide cyaneis, sphericis, foveis profundis confertis cancellatis. Long. ·45—·65. Tab. II, fig. 10.

Lec. Ann. Lyc. Nat. Hist. of New York, V, 158; Proc. Acad. Nat. Sc. VI, 330.

Drs. Wislizenus and Webb, found in the same region with *C. vittatus.*

MORDELLA Fabr.

M. insulata, longiuscula, nigra, capite thoraceque cinereo haud dense pubescentibus, hoc latitudine breviore, lateribus late rotundatis, elytris pube nigra indutis, sutura basique cinereo-marginatis, vitta obliqua a humero ad quadrantem extensa, maculaque transversa pone medium dense cinereo-pubescentibus; subtus maculis lateralibus cinereo-pubescentibus, antennis thorace longioribus basi, tibiis tarsisque anticis fusco-testaceis, stylo anali elongato. Long. ·18—·21.

Two specimens, from Fort Riley; Mr. John Xantus. Approaches *M. oculata* Say, more nearly than any other species, but is readily distinguished by the markings as above described; the oblique vitta from the humerus does not reach the suture; the scutellum is densely clothed with cinereous hair.

MORDELLISTENA Costa.

M. æmula, elongata, parallela, nigra, pilis pallide sericeis obsita, elytris evidenter punctulatis, pedibus posticis, tibiis carinulis numerosis brevibus obliquis, tarsorum articulo 1mo tibia vix breviore, 5-carinulato, 2d bicarinulato. Long. ·18.

One specimen: Platte river. Elongate, not attenuated behind, black, above and beneath with gray silvery hair; head and thorax very finely punctulate, the latter

scarcely wider than long, somewhat narrowed in front, slightly rounded on the sides, bisinuate at the base, with the middle lobe broadly rounded. Elytra more than three times as long as the thorax, parallel on the sides, obtusely rounded behind, distinctly punctulate. Anal style slender. Posterior tibiæ broad, with six or seven very short oblique ridges on the supero-external margin; first joint of posterior tarsi not shorter than the tibia, with five similar oblique ridges; second joint with two.

M. divisa, fusco-nigra, supra dense helvo-pubescens, elongata, postice subattenuata, capite thoraceque ante medium rufo-testaceis, elytris evidenter punctulatis; pedibus posticis, tibiis carinulis 2 vel 3 minutis obliquis, tarsorum articulo 1mo tibia haud breviore cariuulis 4, 2ndo duabus instructo; antennarum basi pedibusque anterioribus rufo-testaceis, unguiculis simplicibus. Long. ·11.

Platte river: resembles *M. marginalis* (*Mordella marg.* Say), but differs by the pubescence being coarser, more abundant, and of a yellowish brown color. The thorax is a little wider than long, not narrowed in front, broadly rounded on the sides, feebly bisinuate at base; the anterior half, with the head is reddish yellow, and the outline separating the yellow from the black is sinuate as in the species above mentioned.

In thus introducing the present genus into the fauna of the United States, a few remarks regarding our numerous species of *Mordellidæ* will be appropriate. The genera which they represent are five in number, and may be thus separated:—

A. Scutellum quadratum, transversum postice subemarginatum	*Tomoxia* Costa.
B. Scutellum triangulare, apice rotundatum;	
a. Palpi maxillares articulo ultimo valde dilatato securiformi	*Glipa* Lec.
b. Palpi maxillares articulo ultimo triangulari;	
Antennæ articulis externis valde transversis, velutinis	*Sphalera* Lec.
Antennæ articulis externis triangularibus, haud transversis;	
Pedes postici simplices	*Mordella* Linn.
Tibiæ tarsique postici carinulis notati	*Mordellistena* Costa.

To *Tomoxia* belong *M. bidentata* Say, and a nearly allied smaller species.

To *Glipa* belongs only *M. hilaris* Say. The body is slender; the outer joints of the antennæ triangular; the maxillary palpi elongated, with the last joint in the form of an obtuse isosceles triangle, attached by its apex. The middle tibiæ are longer than the tarsi; the posterior tibiæ only moderately dilated, longer than the first joint of the tarsi, and destitute of oblique ridges; the anal style is short, truncate and subemarginate.

Sphalera is the genus indicated, but not named by Lacordaire (Gen. Col. V, 609, note). The only native representative known to me is *M. melæna* Germ.

To *Mordella* belong *Anaspis 4-punctata* Say; *M. 8-punctata* Fabr.; *oculata* Say; *insulata* Lec.; *serval* Say; *Anaspis triloba* Say; *M. marginata* Mels.; *lineata* Mels.; *scutellaris* Fabr. (*atrata* Mels.); *undulata* Mels., and four nondescript species.

To *Mordellistena* belong all the other species described by Say, Melsheimer, and myself; natural groups among them may be easily formed by the number and position of the tibial ridges, and the arrangement of the colors of the upper surface. *M. sericans* and one nondescript are remarkable by the posterior tibiæ having a fine carina extending along the upper edge, and only a single very long oblique ridge

on the outer surface. These species do not indicate a generic separation, however, and represent the European *M. testacea*, the type of *Stenalia* Muls.

OPHRYASTES Sch.

O. vittatus, niger, albido-squamosus, rostro trisulcato, sulco medio profundissimo, lateralibus rectis profundis, mox ante oculos abbreviatis, thorace latitudine plus duplo breviore inæquali, parce profunde punctato, lateribus sub-bituberosis, canaliculato, sæpe fusco trivittato, elytris striis vix impressis, profunde punctatis, sutura cuprascente-fusca, interstitiis 3io, 5to et 7mo fusco vittatis. Long. ·41—·48. Tab. I, fig. 13(♂). (*a.* rostrum).

Schönherr, Curc. 1,509; 5,819. Lec. Proc. Acad. Nat. Sc. VI, 443.

Liparus vittatus Say, Journ. Acad. Nat. Sc. III, 316.

Platte and Arkansas rivers; found also at Eagle Pass, Texas. The elytra of the male are but little wider than the thorax; those of the female are more rounded, slightly flattened on the back, and about one half wider than the thorax. The dark vittæ of the thorax and elytra appear to be produced partly by abrasion, as specimens occur in which they are hardly to be seen; but the suture as far as the first stria is covered with brown scales having a coppery reflection.

CLEONUS Sch.

C. lutulentus, ater densissime sordide pubescens, vix variegatus, capite cum rostro grosse disperse punctato, hoc longitudinaliter vage impresso, medio vix carinato, thorace varioloso antrorsum angustato, lateribus antice rotundatis, disco paulo obscuriore, elytris inæqualibus, punctis magnis striatim positis. Long. ·37—·43 (sine rostro).

Santa Fé, Mr. Fendler. Smaller and stouter than *C. trivittatus* Say, with the thorax more densely variolate, and hardly perceptibly excavated or carinated; the elytra have three or four vague impressions, not seen in that species.

C. pulvereus, alatus, niger sordidus, rostro carinato, cum capite vage grosse punctato, fronte foveata, thorace latitudine haud longiore, lateribus subparallelis, antice breviter tubulato, angulis anticis rotundatis, grosse punctato ad basin medio late foveato, lateribus dense albo-pubescentibus, elytris convexis, oblongis postice obtuse rotundatis, striis fortiter punctatis haud impressis, totis dense albo-pubescentibus, lineis tribus curvatis obliquis sub-denudatis utrinque notatis; subtus albo-pubescens, obscuro variegatus. Long. ·5.

Arkansas river, one specimen. Of the same size and shape as *C. vittatus* Say, but very distinct by the thorax being not narrowed gradually in front, and not carinate, as well as by the different color.

C. angularis, niger, rostro carinato, cum capite fortiter vage punctato, fronte late foveata, thorace quadrato, lateribus subsinuatis, pone apicem valde constricto et ad apicem tubulato, angulis pone apicem rectis extantibus, varioloso-punctato, ad basin medio profunde foveato, elytris oblongis convexis, cribrato-striatis, interstitiis cinereo-pubescentibus spatiis denudatis variegatis, alternis cum sutura elevatis; subtus cinereo-pubescens, vix nebulosus. Long. ·36—·45. Tab. I, fig. 12.

Two specimens: collected by Lieut. Beckwith. The first joint of the funiculus of the antennæ is slightly elongated, the others are short; the species, therefore, belongs to the division (called genus by Schönherr) Pachycraerus. The projecting anterior angles of the thorax are very remarkable.

DEROBRACHUS Serville.

D. geminatus, piceus, nitidus, thorace valde transverso, antice non angustato, parce punctulato, lateribus quadrispinoso, spina antica minore, elytris fere lævigatis, margine angustiore reflexo. Long. 2·9. Tab. II, fig. 12 (femina).

Mas minor (long. 1·5—2·25), antennis longioribus crassioribus (fig. 12 *a*), pedibus anticis punctis elevatis exasperatis.

Lec. Proc. Acad. Nat. Sc. VI, 223.

New Mexico and Texas. The only female yet obtained was collected at Albuquerque, by Dr. T. C. Henry; several males were afterwards found by Messrs. Schott and Clark, of the Boundary Commission, at various places in Texas.

PRIONUS Geoffroy.

P. curvatus, piceus, thorace subtiliter parce punctulato, spina anteriore tenui valde acuta, media hamata, angulis posticis subrectis prominulis, elytris subtiliter parce punctulatis et rugosis, spina suturali distincta; oculis magnis, antennis 12-articulatis. Long. 2·06.

One female from near Santa Fé. Resembles nearly *P. californicus* Motsch. (*crassicornis* Lec.), but the anterior spine of the thorax is more slender, and the middle one is curved backwards; the elytra are somewhat less punctured and rugose, but this is not a good character, as judging from a large series of *P. californicus*, it seems subject to variation.

P. fissicornis, nigro-piceus, nitidus, thorace subtiliter parce punctato, lateribus obtuse tridentato, elytris thorace latioribus parce sat grosse punctatis, obsolete costatis. Long. 1·0—1·6. Tab. I, fig. 14 (mas).

Mas antennis crassissimis valde imbricatis 27—30-articulatis, articulis subtus valde incisis (*a*).

Femina antennis tenuibus imbricatis, 25-articulatis, articulis subtus sinuatis (*b*).

Haldeman, Proc. Acad. Nat. Sc. III, 125; Lec. Journ. Acad. Nat. Sc. 2d ser. II, 108.

Platte river, New Mexico, and Texas, not rare.

P. emarginatus, piceus, nitidus, thorace punctatissimo, flavo-piloso, antrorsum angustato, lateribus ante medium unispinoso, angulis posticis rectis, elytris grosse parcius punctatis; antennis 14-articulatis. Long. ·75. Tab. II, fig. 13 (mas).

Mas antennis crassis valde imbricatis, articulis 3—13 ad apicem subtus valde emarginatis. Femina latet.

Say, Journ. Acad. Nat. Sc. III, 327; Lec. ibid. 2nd ser. II, 107.

Kansas and New Mexico, near the Rocky Mountains.

CRIOCEPHALUS Muls.

C. asperatus, piceus tenuiter pubescens, thorace subtransverso, lateribus obtuse angulatis, dorso plano ad latera granulis pareis exasperato, utrinque profunde lunatim excavato, medio subcanaliculato, ad basin fovea maiuscula impresso, elytris thorace parum latioribus, subtiliter rugosis, lineis utrinque duabus elevatis; oculis modice prominulis, genis subacutis; antennis corporis dimidio vix longioribus, versus basin crassiusculis, articulis ultimis quatuor subito brevioribus. Long. ·96.

Kansas and New Mexico. Differs from *C. agrestis* by the more flattened thorax, with more numerous elevated granules, and distinctly angulated sides. The antennæ are also heavier, and do not differ remarkably in length in the two sexes,

and their joints from the eighth to the eleventh are each one-half shorter than the seventh.

DRYOBIUS Lec.

D. sexfasciatus, supra niger nitidus, capite thoraceque flavo-pubescentibus, illo inter antennas glabro transversim elevato, hoc fascia nigra ad medium ornato, latitudine paulo breviore, postice leviter coarctato, punctato, callis tribus dorsalibus notato, ante medium transversim impresso; elytris fasciis tribus apiceque late flavo-pubescentibus; subtus flavo-fasciatus, antennis pedibusque rufis, illis articulis interne subtus longe fimbriatis. Long. ·65—1·0. Tab. I, fig. 15 (femina).

Lec. Journ. Acad. Nat. Sc. 2d ser. II, 23.

Callidium sexfasciatum Say, Journ. Acad. Nat. Sc. III, 415.

Alabama (Prof. Haldeman) and Ohio (Dr. Kirtland): Say found it on the Arkansas river. The antennæ of the female are but little longer than the body, those of the male are one-half longer. The femora are compressed and gradually slightly clavate.

ARHOPALUS Serv. (emend. Lec.)

A. charus, niger subtilissime punctulatus, thorace latitudine sesqui breviore, flavo-pubescente, fasciis tribus angustis nigris, elytris ad apicem oblique intus truncatis, a basi ad quadrantem flavis, gutta utrinque parva ad medium, fascia lata pone medium apiceque flavis, antennis pedibusque nigris. Long. ·85. Tab. I, fig. 16 (var.).

Lec. Journ. Acad. Nat. Sc. 2d ser. I, 17; Proc. Acad. Nat. Sc. VI, 68.

Clytus charus Say, Bost. Journ. Nat. Hist. I, 193.

Missouri, Dr. Engelmann; Creek Boundary, Dr. Woodhouse. The segments of the body beneath are edged with yellow; the humeri are marked with a black dot; the apical yellow spot sometimes includes a black spot, as in the specimen figured. I have seen only females of this species.

STENASPIS Dup.

S. solitaria, atra supra glabra, subtus parce cinereo-pubescens, thorace latitudine fere duplo breviore, parce punctato, ante basin callo lævi alteroque utrinque versus latera modice elevatis, lateribus ipsis bituberculatis, elytris subtilissime strigosis, parce subtiliter punctulatis, pedibus cyanescentibus. Long. 1·43. Tab. II, fig. 14 (femina).

Lec. Proc. Acad. Nat. Sc. VI, 441.

Cerambyx solitarius Say, Journ. Acad. Nat. Sc. II, 410.

Callichroma solitarium Hald. Trans. Am. Phil. Soc. X, 32.

Smileceras solitarium Lec. Journ. Acad. Nat. Sc. 2d ser. II, 9.

New Mexico, Dr. Wislizenus; Kansas, Say; Texas, Messrs. Clark and Schott; Tucson, myself. The male has the antennæ longer than the body and slender.

TYLOSIS Lec.

T. maculatus, niger, thorace elytrisque coccineis, illo latitudine fere duplo breviore, punctato, callis quinque lævibus nigris, elytris confertim punctatis, macula humerali, alterisque utrinque tribus nigris. Long. ·75. Tab. II, fig. 15.

Lec. Journ. Acad. Nat. Sc. 2d ser. II, 9.

New Mexico, Dr. Wislizenus (probably found west of Santa Fé). The humeral spot of the elytra in one specimen is obsolete. The antennæ of the male are much longer than the body.

ACMAEOPS Lec.

A. dorsalis, elongata, nigra opaca, supra parce breviter cinereo-pubescens, capite thoraceque confertissime punctatis, hoc latitudine subbreviore, convexo antice posticeque constricto, lateribus valde rotundatis, subcanaliculato, linea dorsali tenui lævi, elytris thorace latioribus suparallelis, punctatis, vitta subsuturali lutea postice sensim attenuata, et pone medium abbreviata, apice rotundatis, subtus cinereo-pubescens, epimeris dense pubescentibus. Long. ·45.

One specimen, from Republican Fork of Kansas river, kindly given me by Dr. T. B. Wilson. The antennæ are slender and reach two-thirds the length of the elytra; behind the middle of the elytra and extending nearly to the apex is a very obsolete yellowish stripe, which in other specimens may be found to be well developed, in which case there would be on each elytron a subsutural vitta abbreviated behind, and an external one abbreviated in front.

Resembles in appearance some of the varieties of *A. marginalis* Lec. (*? Leptura longicornis* Kirby), but the thorax is more robust and more rounded on the sides, the legs are entirely black, and the apex of the elytra more rounded.

LEPTURA Linn.

L. cribripennis, atra breviter parce pilosa, capite dense, thorace grosse punctato, hoc convexo, lateribus late rotundatis, utrinque constricto, elytris rubris subglabris, cribratim punctatis, ad apicem nigricantibus et intus oblique truncatis bidentatis, dente exteriore longiore; articulis antennarum 4, 5, 6, 9 et 10mo basi pallidis, 6to et 8vo pallidis macula apicali parva nigra notatis. Long. ·7.

One specimen found by me on Platte river. Very nearly allied to *L. cinnamoptera* Kirby, but the elytra are much more coarsely punctured, and the lower half of the fourth joint of the antennæ is pale, while in the latter species there is merely a small pale spot at base.

MONILEMA Say.

M. appressum, nigrum, thorace lateribus non spinosis, antice posticeque parce punctatis, elytris ante medium parce punctatis, dorso antice planis, lateribus subito valde declivibus. Long. ·97. Tab. II, fig. 17.

Lec. Journ. Acad. Nat. Sc. 2d ser. II, 168.

New Mexico: one specimen: Dr. Wislizenus. Differs from the other species known to me by the flattened back and suddenly deflexed sides of the elytra.

STENOSTOLA Muls.

S. saturnina, plumbeo-nigra, undique cinereo-pubescens, thorace latitudine haud longiore, punctato, lateribus subrotundato, pilis subtilibus erectis brevibus parce vestito, versus basin densius pubescente, elytris punctis remotis postice subtilioribus, ad apicem singulatim rotundatis. Long. ·5.

One specimen from Kansas, kindly communicated to me by Mr. Burke. From its color it resembles at first sight *Saperda moesta* and *concolor*, but the short convex front and dentate ungues will at once remind the student of the generic differences. Of the usual smooth thoracic spots seen in the species of this genus, only two very faint ones remain; they are situated about the middle, equidistant from each other and from the side.

AMPHIONYCHA Lec.

A. ardens, minus elongata cylindrica, atra, pube nigra erecta vestita, capite fronte vittisque duabus postice divergentibus læte flammeo-pubescentibus, thorace supra flammeo-pubescente, vitta dorsali atra, latitudine sesqui breviore, lateribus parum sinuatis, elytris thorace paulo latioribus grosse punctatis, margine laterali ad humeros latiore, et ad dodrantem extenso ornatis. Long. ·35.

Fort Riley: John Xantus, Esq. Broader than *A. flammata*, and readily distinguished by the thorax being one half broader than its length, with the lateral vittæ much wider.

Also allied to these two is a third species found in Northern New York, and in New Hampshire; for specimens of it I am indebted to Mr. Henry Ulke, it may be thus characterized:—

A. subarmata, minus elongata cylindrica, atra, pube nigra erecta vestita, capite flammeo-pubescente, thorace latitudine vix breviore, lateribus sinuatis, medio tuberculo acuto prominulo armatis, vitta augusta sublaterali flammeo-pubescente, elytris grosse punctatis juxta suturam late sulcatis, sutura magis elevata. Long. ·26—·28.

ÆDILIS Serv.

Æ. spectabilis, niger subtiliter dense cinereo fuscoque pubescens, thorace fusco maculis albis confluentibus utrinque ornato, elytris basi fasciisque tribus undulatis obliquis fuscis (intermedia latiore) notatis, pedibus fusco-annulatis, antennis longissimis cinereis, articulis 1—5 subtus dense pubescentibus, apice fuscis, 5to fasciculo apicali recurvato interno ornato. Long. ·91. Tab. II, fig. 16.

Lec. Proc. Acad. Nat. Sc. of Philadelphia, VII, 82.

Fort Union: one specimen: Major Sibley. The figure renders unnecessary any farther description of this beautiful species.

LEMA Fabr.

L. trivirgata, elongatula, parallela, testacea nitida, antennis (articulo primo excepto) thoracis maculis duabus (capitisque lateribus, abdominisque maculis sæpe), tibiarum apice tarsisque nigris; thorace latitudine longiore, medio valde coarctato, antice grossius parce punctato; elytris fortius punctato-striatis, interstitiis postice haud elevatis, vitta suturali alteraque submarginali angustis nigris. Long. ·31.

Santa Fé: Mr. Fendler. Similar in appearance to *L. trilineata*, but known at once by the larger punctures of the thorax and elytra. The thorax is also more deeply constricted at the middle, and the outer vitta of the elytra is always narrower, usually extending only from the 9th to the 10th stria; in one specimen this vitta is interrupted behind the humerus. In another the second and third joints of the abdomen are marked each with a medial transverse black spot, and the occiput and two posterior spots of the head are black.

COSCINOPTERA Lac.

C. franciscana, oblonga, antice angustior, postice vix attenuata, nigra, subtus densius, supra sat dense albido-tomentosa, thorace latitudine sesqui breviore, lateribus obliquis parum rotundatis, punctato, linea angusta dorsali lævi, elytris fere dense punctatis, labro flavo-marginato. Long. ·18—·20

Fort Riley: Mr. Xantus. Closely related to *C. dominicana*, but differs by the pubescence of the upper surface being much more dense, and by the elytra being more densely punctured. The sexual characters are as in that species.

CRYPTOCEPHALUS Geoffr.

C. mucoreus, cylindricus, niger nitidus, subtus dense, supra subtiliter cinereo-pubescens, thorace convexo, subtiliter sat dense punctato, spatio parvo dorsali lævi, elytris basi margineque ultra medium late coccineis, maculaque coccinea rotundata apicali utrinque ornatis, punctis magnis striatim digestis, interstitiis parce subtiliter punctatis. Long. ·25.

Fort Riley, one specimen: Mr. John Xantus. It has also been received from Texas by Mr. Ulke. A very distinct species; the elytral markings are a broad basal band curving along the margin to beyond the middle, and a small apical spot. Some of the varieties of *C. notatus* are similarly marked, and it is quite possible that the present species will be found also to vary in this respect.

PARIA Lec.

P. opacicollis, pallide flava, thorace latitudine fere duplo breviore, valde convexo, alutaceo subopaco, parce subtiliter punctulato, lateribus late rotundatis, elytris antice fortiter postice subtilius striatim punctatis, nitidis, margine postice, sutura, maculisque 4 sæpe nigris. Long. ·13.

Fort Laramie: a very pretty species, readily distinguished by the faint sculpture of the thorax. The spots are placed, an oblong one at the middle of the base, and a larger quadrate one at the middle nearer the side than the suture.

P. pumila, saturate rufo-testacea, nitida, thorace convexo, quadrato, antice paulo angustato, lateribus parum rotundatis, parce punctato, elytris convexis, punctis paucis striatim positis ad basin majoribus, postice fere lævibus; antennis nigris, ad basin pedibusque flavis, pectore nigro. Long. ·10.

One specimen sent me by the late A. Melly, Esq., as coming from Kansas. The striæ consist only of a few distant large punctures towards the base, which become rapidly smaller and indistinct behind.

HETERASPIS.

H. nebulosa, cuprea, pube longa albida irregulariter vestita, capite inter oculos profunde angulatim impresso, fronte canaliculata, occipite bifoveato, thorace irregulariter punctato, latitudine haud longiore, ad basin truncato, lateribus rotundatis, elytris thorace latioribus convexis, striis grosse punctatis haud impressis postice obsoletis, interstitiis alutaceis. Long. ·15—·19.

Kansas, near Fort Laramie. The genus *Heteraspis* belongs in the vicinity of Eumolpus, and is distinguished from the other native genera by the following assemblage of characters:—

The mouth and eyes are not protected by the thorax, which beneath is simply truncate; the head is marked with a deep impression between the eyes; this impression is angulated each side, and continues around the inner posterior and inferior part of the eyes, forming a kind of orbit. The ungues are armed with a long acute tooth in *H. pubescens* Mels.; with a short acute tooth in *H. curtipennis* Mels., and in the next species, while in the one here described the tooth is almost obsolete.

H. smaragdula, viridi-ænea, parce albo-pubescens, capite profunde angulatim impresso, fronte vix canaliculata, thorace latitudine haud longiore, lateribus rotundatis, ad basin late rotundato, punctato subrugoso versus apicem sublævi, elytris longiusculis, convexis, thorace latioribus, striis haud impressis antice punctatis postice obsoletis, interstitiis alutaceis parce punctulatis. Long. ·20.

One specimen found at Fort Laramie.

MYOCHROUS.

M. squamosus, longiusculus, piceo-æneus, dense griseo-squamosus, breviter pubescens, capite thoraceque confertissime punctatis, hoc subrotundato, lateribus haud dentatis, elytris thorace non latioribus, punctis subquadratis striatim positis, postice obsoletis; tibiis anticis intus subarmatis, femoribus posticis haud dentatis; antennis versus basin rufis. Long. ·18.

Platte river, under dried buffalo excrement. Differs abundantly from *M. denticollis* by the absence of serration on the sides of the thorax, as well as by the posterior femora being not armed with a tooth; the scales of the upper surface of the body are broad.

The genus *Myochrous* consists of elongated pubescent Eumolpi, in which the thorax is slightly lobed behind the eyes; the latter are small and prominent; the antepectus is excavated for the reception of the head; the claws of the tarsi are not perceptibly toothed. The anterior tibiæ are armed with a more or less prominent denticle on the inner surface near the middle; the posterior femora are sometimes simple, and sometimes toothed.

ŒDIONYCHIS Latr.

Œ. lugens, elongato-ovalis, atra opaca, thorace elytrisque anguste marginatis, illo disperse punctato,, ad basin late rotundato, abdominis segmentis dorsalibus pallidis. Long. ·21.

Santa Fé, Mr. Fendler. Of the same shape, but smaller than *Œ. concinna* (*Haltica concinna* Fabr.), and easily known by its dull opaque black color, and by the base of the thorax not being sinuate near the posterior angles. The elytra appear impunctured; the pale color of the dorsal surface of the abdomen shows a little beneath at the margin and tip.

Œ. lobata, pallida, thorace angulis anticis acutis, lateribus late reflexis, elytris nigro-piceis subtiliter punctatis, basi versus scutellum latius, margine laterali trilobato, maculisque utrinque duabus disci pallidis, sutura anguste pallescente; subtus fusco-testacea, pedibus pallidis. Long. ·20.

One specimen from Kansas river. Allied to *Œ. quercata*, but larger, and with the elytra less broadly margined; the arrangement of the colors on the latter is also very different.

HALTICA Illiger.

H. punctigera, oblongo-ovalis, pallide flava, thorace latitudine duplo breviore, punctulato, lateribus rotundatis marginatis, dorso convexiusculo, punctis 4 nigris notato (externis sæpe deficientibus), elytris dense subtiliter punctatis, sutura, vitta discoidea apicem haud attingente, alteraque juxta marginem nigris, tibiarum apicibus, tarsis antennisque fuscis, his articulis tribus primis subtus flavis. Long. ·30.

Kansas, near the Rocky mountains. Belongs with a numerous series of species allied to *H. alternata;* it is broader than that species, the thorax is more convex and more rounded on the sides; and the elytra are finely, but strongly and densely punctured.

H. pluriligata, pallide flava, elongata, thorace latitudine sesqui breviore, fere obsolete punctulato, guttis nigris quatuor, lineolaque dorsali versus basin ornato, lateribus rotundatis marginatis, elytris subtiliter parce punctulatis, sutura, vitta discoidea apicem haud attingente, alteraque juxta margiuem nigris; tibiis ad apicem, tarsisque fuscis, antennis nigro-piceis, articulis tribus primis flavis supra infuscatis. Long. ·32.

Kansas and Texas. Also allied to *H. alternata,* but narrower and with a less transverse thorax. Both this and the preceding, as well as the next species belong to Chevrolat's division (called genus by some authors) *Disonycha.*

H. cervicalis, ovalis, pallide flava, capite, antenuis, pedibus, elytrisque nigris, his punctulatis subalutaceis; thorace subtilius marginato, lævi. Long. ·2.

Kansas and Georgia. Very similar to *H. collaris,* but rather stouter than that species, and distinguished by the uniform pale-yellow color of the under surface.

H. semicarbonata, ovalis convexa, fusco-atra, elytris opacis subtiliter punctatis, thorace parce punctulato, flavo, ad basin versus angulos posticos rectos sinuato, clypeo, abdominis segmento ultimo ventrali, coxis femoribusque flavis; antennarum articulis 1—3 subtus, tibiisque posticis ad basin flavis. Long. ·24.

Santa Fé: one specimen: Mr. Fendler. Belongs to the division named *Disonycha* by Chevrolat, and resembles in appearance *H. collaris* Fabr., but is broader, having the form of *H. cervicalis;* it is readily distinguished from both by the dull elytra and different arrangement of the colors beneath.

H. ambiens, elongata, convexa, cyanea nitida, thorace viresceute, punctulato, ad basin late rotundato, ante basin profunde transversim sulcato, sulco versus angulos profundiore, elytris subtiliter punctulatis, carina submarginali distincta, postice curvata et versus suturam obliterata. Long. ·22.

Santa Fé: Mr. Fendler. Differs from *H. subplicata* in the smaller size, and by the more elevated submarginal costa of the elytra being curved behind. It nearly resembles a nondescript species from New Hampshire (*H. alni* Harris), but the thorax is more convex, and the elytra more deeply punctured, while the curved portion of the costa is less prolonged towards the suture; in both the elytra are broadly sulcate about the middle, just within the costa.

H. subplicata, elongata, obscure cyanea, parum nitida, thorace latitudine paulo breviore, subtiliter punctulato, lateribus rectis angulis omnibus distinctis, postice fortiter transversim sulcato, elytris parce punctulatis, plica submarginali minus elevata versus apicem sensim obliterata notatis. Long. ·25.

One specimen: found in Platte river valley. Belongs to a numerous group of the division *Graptodera* Cherv., having an elevated fold parallel with the outer margin of the elytra; this fold in the other species is, however, much more elevated and curved posteriorly towards the suture.

H. punctipennis, elongata, læte viridi-ænea, thorace antrorsum angustato, latitudine sesqui breviore, lateribus late rotundatis, vix subtiliter punctulato, postice transversim tenuiter obsolete sulcato, elytris thorace paulo latioribus, distincte licet subtiliter punctatis, antennis nigris. Long. ·2.

Kansas and Santa Fé. Specimens from New Mexico were collected by the late Richard C. Kern, Esq., and were given to me by Prof. S. S. Haldeman. This is a *Graptodera* of slender form, and is readily distinguished by the distinctly punctured elytra, and by the slight posterior impression of the thorax.

H. obliterata, elongata, chalybeo-atra subopaca, thorace subtiliter punctulato, ad basin late rotundato, ante basin stria transversa subtili impresso, elytris subtiliter fere obsolete punctulatis. Long. ·27.

One specimen, Mr. Fendler. Very distinct from other species of *Graptodera* known to me, by the fine transverse line of the thorax being obliterated towards the sides.

H. torquata, elongata, thorace punctulato ad basin late rotundato, ante basin profunde transversim sulcato, plus minusve cupreo, elytris chalybeis purpureo micantibus, confertim punctulatis, margine laterali cupreo-æneis; subtus obscure ænea, pedibus purpureo-chalybeis. Long. ·2.

Santa Fé, Messrs. Fendler and Kern. An elongate *Graptodera* distinguished by the color and the fine dense punctuation of the elytra, from all the species that resemble it.

H. bitæniata, elongata nigro-picea, supra pernitida, capite postice pallidiore, thorace fusco-testaceo, maculis tribus obscuris, parce punctulato, ante basin transversim leviter impresso, et in medio foveato, elytris punctulatis nigris, vitta lata dorsali margineque (mox ante apicem sæpe connexis) pallidis; antennis pedibusque fusco-testaceis, femoribus posticis obscuris. Long. ·18—·21.

Santa Fé, Mr. Fendler. Larger than *H. elongata* Fabr. (*tæniata* Say), and with it, belongs to the division *Systena* Chevr. The marginal and dorsal vittæ sometimes unite near the tip.

LONGITARSUS Latr.

L. nigripalpis, elongata, alata, flavo-testacea, oculis palpisque nigris, fronte carinata, vertice tuberculis duobus parum elevatis, linea impressa definitis, thorace latitudine breviore, lateribus rotundatis, valde convexo, alutaceo, ante basin transversim sulcato, elytris thorace latioribus oblongis, subtiliter punctulatis pone basin late impressis; tibiis posticis elongatis haud sulcatis, calcari parvo terminatis. Long. ·12.

One specimen, Platte river. The first joint of the hind tarsi is somewhat less than half the length of the tibia; the antennæ are lost. Differs from the other species by the non-sulcate hind tibiæ.

L. subrufus, rufo-testaceus, nitidus, fronte carinata, thorace latitudine haud breviore, angulis rotundatis, convexo, haud dense punctato, elytris thorace latioribus, ovalibus convexis, subtiliter punctatis, introrsum vix conspicue striatis; tibiis posticis sulcatis, calcare brevi terminatis, antennis corpore vix brevioribus, extrorsum infuscatis. Long. ·12.

Fort Laramie. The upper edge of the hind tibiæ is finely serrate; the tarsus is as long as the tibia.

L. rubidus, apterus, ovatus, piceo-ferrugineus, nitidus, capite infuscato, fronte carinata, vertice transversim impresso, thorace transverso, basi et angulis rotundatis, convexo, alutaceo, subtiliter parce punctulato, elytris ovalibus convexis, sat dense minus subtiliter punctatis, antennis testaceis, extrorsum vix infuscatis, corpore paulo brevioribus. Long. ·11.

Fort Laramie. The spur of the hind tibia is short; the tarsus is as long as the tibia; the elytra are obtusely rounded at tip, and the pygidium is slightly prominent.

GLYPTINA Lec.

G. spuria, testacea, nitida, fronte elevata, vertice bituberculato utrinque oblique impresso, thorace transverso, basi rotundato, lateribus parallelis angulis anticis oblique truncatis, punctato, elytris oblongo-ovalibus thorace latioribus, fortiter punctato-striatis; antennis extrorsum fuscis. Long. ·08.

Fort Laramie. I have given the name *Glyptina* to a group of *Haltica* intermediate between genuine *Haltica* and *Longitarsus*. The head is marked with a deep oblique line each side between the eyes, running forward to the frontal elevation: the antennæ are half as long as the body, slightly thickened externally; the 2d and 3d joints equal in length: the thorax is quadrate, transverse, with the anterior angles obliquely truncate, the disc moderately convex, without impressed lines. The elytra oblong, wider than the thorax, with rows of punctures; the hind tibiæ deeply sulcate above, with the edge of the groove very finely serrate, the terminal spur small, the tarsi attached at the end of the tibiæ, 1st joint equal to the others combined, and nearly half as long as the tibiæ. Besides the two species here described, the Californian *Haltica cerina* Lec., Pacific R. R. Expl. and Surveys, vol. xi, insects, 68, also belongs to this genus.

G. lissotorques, testacea, nitida, fronte parum elevata, vertice utrinque oblique sulcato, thorace transverso, basi rotundato, lateribus parallelis, angulis anticis oblique truncatis, nitido, lævi, vix obsolete parce punctulato, elytris oblongo-ovalibus, thorace latioribus, fortiter punctato-striatis; antennis extrorsum vix infuscatis. Long. ·08.

One specimen with the preceding, which it entirely resembles, except in the sculpture of the head and thorax. It is also found in Pennsylvania.

CHÆTOCNEMA Stephens.

C. subviridis, supra viridi-ænea, obscura, subnitida, thorace latitudine fere duplo breviore, lateribus obliquis late rotundatis, fortius sat dense punctato, elytris fortiter striato-punctatis, interstitiis subtiliter uniseriatim punctulatis, pedibus antennisque nigris, his basi testaceis, tibiis basi vix picescentibus. Long. ·12.

Fort Laramie. Broader than *C. denticulata*, and differing therefrom in many particulars. I have retained the older name for this genus, as I know no reason for the substitution of Redtenbacher's *Plectroscelis*, which is adopted by many naturalists of Germany and France.

LUPERUS Geoffroy.

L. rufipes, elongatus, chalybeo-niger, thorace parce punctulato, latitudine haud breviore, lateribus late rotundatis subsinuatis, angulis posticis prominulis, elytris fere obsolete punctulatis, chalybeis, antennis pedibusque rufo-testaceis, illis extrorsum fuscis. Long. ·22.

Santa Fé, Messrs. Kern and Fendler. Of the form and size of *L. meraca* (*Galleruca meraca* Say), but known by the uniform color of the feet, the less distinctly punctulate elytra, and the less rounded sides of the thorax.

MICRORHOPALA Chevr.

M. lætula, elongata, postice modice dilatata, et obtuse rotundata, nigra, capite pone antennas, thoraceque toto læte rufo-flavis, hoc parce cribrato, transverso, lateribus obliquis rectis, elytris punctis magnis striatis, seriebus per paria approximatis, internis postice subtilioribus, vittaque utrinque basali ante medium abbreviata flava. Long. ·25.

Fort Riley, Mr. Xantus. Closely related to *M. vittata*, but differs by the sides of the thorax being entirely straight, as well as by the colors; the thorax is very narrowly margined with black, but is yellow both above and beneath, as is also the

head, excepting the antennæ, front and mouth, which are black. The outer intervals of the elytra are not shining, and are alternately a little more convex, as in *M. vittata*, and the edge is not serrate.

CASSIDA Linn.

C. ellipsis, elliptica convexa, supra testacea pallida, nitida (quando viva, læte aurea), thorace antice rotundato, margine late explanato hyalino, angulis lateralibus paulo rotundatis, elytris thorace haud latioribus, fortius striato-punctatis, margine subhyalino, antice declivi postice explanato angustius reflexo, capite corporeque nigris, abdomine anguste testaceo marginato, pedibus antennisque flavis, his articulis 3—6 tenuibus æqualibus, 7—11 latioribus, ultimis quatuor nigris. Long. ·26.

One specimen, found near Long's Peak. Allied by the declivous and scarcely explanate but narrowly reflexed elytral margin, to *C. 6-punctata* and *C. 9-maculata*, but differing by the more narrow, regularly elliptical form of body. The legs in *C. 9-maculata* are black; in *C. 6-punctata* they are reddish yellow, but the punctures of the striæ of the elytra in that species are less approximate, each elytron is marked with three black spots, the humeral angles are more prolonged, and the side angles of the thorax are more rounded. Still more essential differences exist in the antennæ: in the present species the 2d joint is a little longer than wide; the 3d is slender, one-half longer than the 2d; the 4th, 5th, and 6th are equal in length and thickness to the 3d; the 7th is more than twice as wide, triangular, pale yellow, like the preceding joints; the remaining four joints are as wide as the 7th, and black. The middle of the anterior margin of the thorax is slightly emarginate, but I suspect this character to be accidental.

C. atripes, ovata, convexa, supra testacea (quando viva læte aurea), thorace antice rotundato, margine hyalino late explanato, angulis externis haud rotundatis, elytris thorace vix latioribus, humeris paulo productis rotundatis, striis e punctis parcis constitutis, margine hyalino antice declivi postice explanato, vix reflexo, utrinque guttis tribus nigris notatis; subtus nigra, abdomine testaceo-marginato, antennis basi flavis, articulis 3—5 æqualibus, 6to paulo latiore, ultimis 5 nigris. Long. ·23.

One specimen, found near Long's Peak. Differs from *C. nigripes* chiefly by the thorax being nearly as wide as the elytra, with the lateral angles scarcely rounded: the margin of the elytra anteriorly is more obliquely declivous than in that species.

With regard to the position of *C. unipunctata* Say, I am somewhat doubtful, although to avoid the multiplication of genera it should probably be allowed to remain in *Cassida*. The 2d joint of the antennæ is scarcely thicker than the 3d, which is about twice as long; the 4th is two-thirds as long as the 3d, and somewhat wider; the 5th is as wide as its length; and the remaining ones are a little wider than their length: the last is oval and pointed. The ungues, as in our other species, are simple.

BRACHIACANTHA Muls.

B. tau, rotundato-ovalis, convexa, supra rufo-flava, nitida dense subtiliter punctulata, thorace basi subinfuscato, elytris fascia basali ad humerum abbreviata, sutura anguste, guttisque utrinque duabus paulo pone medium nigris, margine externo pone maculas, apicalique nigro, subtus nigra, antennis, palpis, pleuris pedibusque flavis. Long. ·19.

One specimen, Fort Riley: John Xantus, Esq. The head and sides of the thorax are paler than the rest of the upper surface.

EROTYLUS Fabr.

E. Boisduvalii, oblongus, ater, subnitidus, elytris sat convexis, albido-testaceis, punctis maioribus nigris minus crebre impressis, singulo macula parva laterali nigra ornato. Long. ·6—·62. Tab. II, fig. 8.

Chevrolat, Col. Mex. 2d cent.; Lac. Mon. Erotyl. 466.

A large number of this species was contained in the collection made by Mr. Fendler, near Santa Fé.

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CICINDELIDÆ.

Amblychila Say.

cylindriformis *Say.*
A. Piccolominii Reiche.

Megacephala Latr.

virginica *Dej.*
Cicindela virginica Linn.

Cicindela Linn.

pulchra *Say.*
scutellaris *Say.*
sexguttata *Fabr.*
purpurea *Oliv.* var. *Audubonii* Lec.
obsoleta *Say.*
prasina *Lec.* Trans. Am. Phil. Soc. XI, 31.
nigrocœrulea *Lec.*
cinctipennis *Lec.*
pusilla *Say.*
cyanella *Lec.* Trans. Am. Phil. Soc. XI, 46.
terricola *Say.*
cuprascens *Lec.*
sperata *Lec.* Trans. Am. Phil. Soc. XI, 50.
lepida *Dej.*
hirticollis *Say.*
C. albohirta Dej.
vulgaris *Say.*
C. obliquata Dej.
fulgida *Say.*
venusta *Lec.*
formosa *Say.*
punctulata *Fabr.*
œmatilis *Lec.*
C. Guexi Chevr.
circumpicta *Fertè.*
C. Johnsonii Fitch, N.Y. Agr. Soc. 1856, 487.
celeripes *Lec.*
cursitans *Lec.* Trans. Am. Phil. Soc. XI, 60.
limbata *Say* (fide Say).
decemguttata *Say* (fide Say).

CARABIDÆ.

Brachinus Weber.

cyanipennis *Say.*
and four other species.

Helluomorpha Lap.

laticornis *Lap.*
Helluo laticornis Dej.
praeusta *Lap.*
Helluo praeustus Dej.

Galerita Fabr.

dubia *Lec.*
'*Carabus bicolor* Drury,' fide Klug.
atripes *Lec.* Proc. Acad. Nat. Sc. 1858, 59.

Lachnophorus Dej.

elegantulus *Mann.*
Tachypus mediosignatus Ménét.

Casnonia Latr.

pensylvanica *Dej.*
Attelabus pensylvanicus Linn.

Leptotrachelus Latr.

dorsalis *Latr.*
Odacantha dorsalis Fabr.
Spheracra dorsalis Say.

Lebia Latr.

viridipennis *Dej.*
L. borca Hentz.
smaragdula *Dej.*
viridis *Say; Dej.*
pumila *Dej.*
L. floricola Harris.
solea *Hentz.*
L. scapularis Dej.
furcata *Lec.*
axillaris *Dej.*

Blechrus Motsch.

linearis *Schaum.* Ins. Deutschl. I, 275.
Dromius angustus‖Lec.
Bomius linearis Lec.

Axinopalpus Lec.

biplagiatus *Lec.*
Dromius biplagiatus Dej.

Glycia Chaud.

viridicollis *Lec.*
Cymindis viridicollis Lec.
purpurea *Lec.*
Cymindis purpurea Say.
var. *Cymindis amoena* Lec.

Calleida Dej.

punctata *Lec.*
smaragdina *Dej.*

Cymindis Latr.

laticollis *Say.*
cribricollis *Dej.*
cribrata *Lec.*
pilosa *Say*
C. pubescens Dej.

Calathus Bon.

gregarius *Dej.*
Feronia gregaria Say.

Rhadine Lec.

larvalis *Lec.*

Platynus Bon. emend. Brullé.

extensicollis *Lec.* Proc. Acad. Nat. Sc. VII, 46.
Feronia extensicollis Say.
Feronia (Anchomenus) proximus Harris.
Anchomenus extensicollis Dej.
Anchomenus obscuratus Chaud.
Anchomenus Lecontei Lec.
Anchomenus elongatulus‡Lec.
Anchomenus viridis Lec.
punctiformis *Lec.* ibid. VII, 50.
Feronia punctiformis Say.
Agonum rufipes Dej.
Agonum foveicolle Chaud.
errans *Lec.* ibid. VII, 50.
Feronia errans Say.
subcordatus *Lec.* ibid. VII, 51.
Agonum erythropum‖Kirby.
basalis *Lec.* Proc. Acad. Nat. Sc. VII, 52.
Agonum basale Lec.
nutans *Lec.* ibid. VII, 52.
Feronia nutans Say.
Agonum femoratum Dej.
picipennis *Lec.* ibid. VII, 53.
Agonum picipenne Kirby.
chalceus *Lec.* Agassiz' Lake Sup. 205.
Agonum chalceum Lec.
maculifrons *Say* (Feronia), (fide Say).
scutellaris *Say* (Feronia), (fide Say).
? Agonum melanarium Dej.
? Platynus melanarius Lec.

Evarthrus Lec.

sigillatus *Lec.* Journ. Acad. Nat. Sc. 2d ser. II, 228.
Feronia sigillata Say.
Feronia vidua Dej.
seximpressus *Lec.* ibid.
Feronia seximpressa Lec.
corax *Lec.* ibid. II, 229.
Feronia corax Lec.
abdominalis *Lec.* ibid. II, 232.
Feronia abdominalis Lec.
lixa *Lec.* ibid.
Feronia lixa Lec.
incisus *Lec.* ibid.
Feronia incisa Lec.
ovipennis *Lec.* ibid.
Feronia ovipennis Lec.
latebrosus *Lec.* ibid. II, 233.
constrictus *Lec.* ibid.
Feronia constricta Say
substriatus *Lec.* ibid.
Feronia substriata Say.
colossus *Lec.* ibid.
Feronia colossus Say.
heros *Hald.* Proc. Acad. Nat. Sc. VI, 361.
Feronia heros Say.

Pterostichus Bon.

caudicalis *Lec.*
Feronia caudicalis! Say.
Feronia luctuosa Dej.
Omaseus nigrita‡Kirby.
Pterostichus luctuosus Lec. loc. cit. II, 243.
mutus *Lec.*
Feronia muta Say.
Feronia morosa Dej.
Omaseus picicornis Kirby.

Poecilus Bon.

scitulus *Lec.*
cyaneus *Lec.*
chalcites ——.
Feronia chalcites Say.
Poecilus Sayi Brullé.

lucublandus *Kirby.*
Feronia lucublanda Say.
bicolor *Lec.*

Amara Bon.

laticollis *Lec.*
? Curtonotus convexiusculus‡Kirby.
carinata *Lec.*
furtiva *Say.*
libera *Lec.* Proc. Acad. Nat. Sc. VII, 349.
Isopleurus hyperboreus‡Lec.
? Curtonotus latior Kirby.
angustata *Say.*
A. indistincta Hald.
impuncticollis *Say.*
A. difficilis Lec.
subpunctata *Lec.* Proc. Acad. Nat. Sc. VII, 352.
confusa *Lec.*
polita *Lec.*
obesa *Say.*
A. patricia‡Dej.
Feronia obesa Say.
diffinis *Lec.* Proc. Acad. Nat. Sc. VII, 354.
Percosia diffinis Lec.
terrestris *Lec.* Proc. Acad. Nat. Sc. VII, 354.
Isopleurus terrestris Lec.
musculus *Say.*
Acrodon musculis et *contempta* Lec.

Nothopus Lec.

zabroides *Lec.*
Euryderus‖*zabroides* Lec.

Geopinus Lec.

incrassatus *Lec.*
Daptus incrassatus Dej.

Cratognathus Dej.

setosus *Lec.* Trans. Am. Phil. Soc. X, 381.
Piosoma setosum Lec.

Cratacanthus Dej.

dubius *Lec.*
Harpalus dubius Beauv.
Cratacanthus pensylvanicus Dej.

Agonoderus Dej.

lineola *Dej.*
Carabus lineola Fabr.
dorsalis *Lec.*
pallipes *Dej.*
Carabus pallipes Fabr.

Discoderus Lec.

parallelus *Lec.* Trans. Am. Phil. Soc. X, 382.
Selenophorus parallelus Hald.

tenebrosus *Lec.* ibid. 382.
Selenophorus tenebrosus Lec.

Spongopus Lec.

verticalis *Lec.*

Anisodactylus Dej.

rusticus *Dej.*
Harpalus rusticus Say.
Anisodactylus pinguis Lec.
Anisodactylus gravidus Lec.
Anisodactylus crassus Lec.
agricola *Dej.*
Harpalus agricolus Say.
Harpalus paradoxus Hald.
Anisodactylus striatus Lec.
baltimorensis *Dej.*
Harpalus baltimorensis Say.
cænus *Dej.*
Harpalus cænus Say.

Eurytrichus Lec.

terminatus *Lec.*
Feronia terminata Say.
Harpalus terminatus Dej.

Harpalus Latr.

impotens *Lec.* Journ. Acad. Nat. Sc. 2d ser. IV, 14.
pedicularius *Lec.*
Selenophorus pedicularius Dej.
troglodytes *Lec.*
Selenophorus troglodytes Dej.
æreus *Lec.*
Selenophorus æreus Lec.
Selenophorus planipennis Lec.
ellipticus *Lec.*
Selenophorus ellipticus Dej.
caliginosus *Say.*
Carabus caliginosus Fabr.
amputatus *Say.*
H. Stephensii Kirby.
rotundicollis *Kirby.*
pensylvanicus *Lec.*
Carabus pensylvanicus De Geer.
Carabus bicolor Fabr.
Harpalus faunus‡Dej.
compar *Lec.*
H. pensylvanicus Say.
H. bicolor‡Dej.
stupidus *Lec.*, ante, 3.
oblitus *Lec.*, ante, 2.
nitidulus *Chaud.*
herbivagus *Say.*
ellipsis *Lec.*
ventralis *Lec.*
funestus *Lec.*

Stenolophus Dej.

ochropezus *Dej.*
Feronia ochropeza Say.
humilis *Lec.*
Acupalpus humilis Dej.
dissimilis *Dej.*

Bradycellus Er.

obesulus *Lec.*
badiipennis *Lec.*
Geobænus ruficrus‡Lec.
Stenolophus badiipennis Hald.
congener *Lec.*
Geobænus congener Lec.
rupestris *Lec.*
Trechus rupestris Say.
Acupalpus elongatulus Dej.
Trechus flavipes Kirby.

Badister Clairv.

notatus *Hald.*
B. terminalis Lec.
micans *Lec.*

Diplochila Brullé.

laticollis *Lec.*
gens maior Lec.
obtusa *Lec.*

Dicælus Bon

lævigatus *Lec.*
splendidus *Say.*
sculptilis *Say.*
simplex *Dej.*
var. *D. obscurus* Lec.
elongatus *Dej.*

Oodes Bon.

amaroides *Dej.*

Atranus Lec.

pubescens *Lec.*
Anchomenus pubescens Dej.
Anchomenus obconicus Hald.

Chlænius Bon.

purpuricollis *Randall.*
tomentosus *Dej.*
Epomis tomentosus Say.
Amara luctuosa Germ.
pensylvanicus *Say.*
C. vicinus Dej.
C. pubescens Harris.
vafer *Lec.* Proc. Acad. Nat. Sc. VI, 66.
æstivus *Say.*
C. cobaltinus Dej.
erythropus Germ.
C. rufilabris Dej.
laticollis *Say.*
C. diffinis Chaud. Bull. Mosc. 1856, II, 279.
lithophilus *Say.*
C. viridanus Dej.
sericeus *Say.*
Carabus sericeus Forster.
Chlænius perviridis Lec.
solitarius *Say.*
brevilabris *Lec.*
var. *C. consimilis* Lec.
impunctifrons *Say.*
C. emarginatus‡Kirby.

Anomoglossa Chaud.

emarginata *Chaud.* Bull. Mosc.
Chlænius emarginatus Dej.

Pasimachus Bon.

validus *Lec.*
P. punctulatus‡Lec.
elongatus *Lec.*
obsoletus *Lec.*
costifer *Lec.* Proc. Acad. Nat. Sc. VII, 79.

Scarites Fabr.

subterraneus *Fabr.* cum var.

Clivina Latr.

bipustulata Dej.
Scarites bipustulatus Fabr.
Scarites quadrimaculatus Beauv.
postica *Lec.*

Aspidoglossa Putz.

subangulata *Lec.*
Clivina crenata‡Dej.
Dyschirius subangulatus Chaud.
Dyschirius humeralis Chaud.
Aspidoglossa fraterna Putz.
Aspidoglossa vicina Putz.
Clivina bipustulata‡Say.

Dyschirius Bon.

sulcatus *Lec.*
apicalis‖Lec.
sphæricollis *Putz.*
Clivina sphæricollis Say.

Tachys Knoch.

vivax *Lec.*
var. *T. mendax* Lec.

incurvus *Lec.*
Bembidium incurvum Say.
var. *Tachys anceps* Lec.
pulchellus *Ferté.*
dolosus *Lec.*
sequax *Lec.*
corruscus *Lec.*
inornatus *Lec.*
Bembidium inornatum Say.
Tachyta picipes Kirby.
flavicauda *Lec.*
Bembidium flavicaudum Say.

Bembidium Latr. (emend. Lec.)

punctato-striatum *Say.*
stigmaticum Dej.
? *sigillare* Say.
inæquale *Say.*
arenarium Dej.
lævigatum *Say.*
Hydrium lævigatum Lec.
coxendix *Say.*
Odontium coxendix Lec.
americanus *Dej.*
cordatum *Lec.*
dorsale *Say.*
umbratum *Lec.*
viridicolle *Lec.*
Notaphus viridicollis Fertè.
patrnele *Dej.*
rapidum *Lec.*
timidum *Lec:*
pictum *Lec.*
quadrimaculatum *Gyll.*
Carabus quadrimaculatus Linn.
Bembidium oppositum Say.
affine *Say, Dej.*
Bembidium fallax Dej.
bimaculatum *Lec.*
Peryphus bimaculatus Kirby.
perspicuum *Lec.*
cautum *Lec.*
nitidum *Lec.*
Eudromus nitidus Kirby.

Cychrus Fabr.

elevatus *Fabr.*
heros *Harris.*

Nomaretus Lec.

cavicollis *Lec.*, ante, 3.

Carabus Linn.

serratus *Say.*
C. lineatopunctatus Dej.

Calosoma Fabr.

luxatum *Say.*
striatulum *Lec.*, ante, 4.
scrutator *Fabr.*
calidum *Fabr.*
var.? *C. lepidum* Lec.
obsoletum *Say.*
C. luxatum‡Dej.
triste *Lec.*
externum *Lec.*
Carabus externus Say.
Calosoma longipenne Dej.

Elaphrus Fabr.

Clairvillei *Kirby.*
intermedius *Kirby.*
californicus *Mann.*
var.? *E. similis* Lec.

Omophron Latr.

americanum *Dej.*
O. Sayi Kirby.
nitidum *Lec.*

DYTISCIDÆ.

Haliplus Latr.

fasciatus *Aubé.*
immaculicollis *Harris.*
H. americanus Aubé.
H. impressus‡Kirby, teste White, Brit. Mus. Cat. 3.

Hydroporus Clairv.

punctatus *Aubé.*
Laccophilus punctatus Say.
cuspidatus *Germ.*
Hyphidrus notatus Say.
lacustris *Say.*
H. pulicarius Aubé.
mixtus *Lec.* Proc. Acad. Nat. Sc. VII, 296.
semirufus *Lec.* ibid.
vittatus *Lec.* ibid.
catascopium *Say.*
H. interruptus Say.
H. parallelus Say.
concinnus *Lec.* Proc. Acad. Nat. Sc. VII, 297.
patruelis *Lec.* ibid. VII, 298.
nubilus *Lec.* ibid. VII, 298.
discoideus *Lec.* ibid. VII, 299.

Laccophilus Leach.

maculosus *Say.*
americanus *Aubé.*

Coptotomus Say.

longulus *Lec.*

Copelatus Er.

glyphicus *Lec.*
Colymbetes glyphicus Say.
Copelatus 10-striatus Aubé.

Agabus Leach.

clavatus *Lec.*, ante, 4.
griseipennis *Lec.*, ante, 5.
obliteratus *Lec.*, ante, 5.
spilotus *Lec.*, ante, 5.
tæniolatus *Lec.*
Colymbetes tæniolatus Harris.
Agabus tæniatus Aubé.

Ilybius Er.

laramæus *Lec.*, ante, 4.

Colymbetes Clairv.

binotatus *Harris.*
C. maculicollis Aubé.

Acilius Leach.

ornaticollis *Aubé.*
Thermonectes irroratus Mels.

Eunectes Er.

sticticus *Er.*
Dytiscus sticticus Linn.

Cybister Curtis.

fimbriolatus *Lec.*
Dytiscus fimbriolatus Say.
Cybister dissimilis Aubé.

Dytiscus Linn.

anxius *Mann.*
D. marginicollis Lec.
Harrisii *Kirby.*

GYRINIDÆ.

Dineutes M'Leay.

two species.

HYDROPHILIDÆ.

Helophorus Fabr.

linearis *Lec.* Proc. Acad. Nat. Sc. VII, 357.
lineatus *Say.*

Laccobius Er.

agilis *Lec.* Proc. Acad. Nat. Sc. VII, 363.
Hydrophilus agilis Randall.
Laccobius punctulatus Mels.

Berosus Leach.

fraternus *Lec.* Proc. Acad. Nat. Sc. VII, 364.

Hydrophilus Geoffr.

triangularis *Say.*
Hydrophilus lugubris Motsch.
Stethoxus subsulcatus Lec. Proc. Acad. Nat. Sc. VII, 221.
lateralis Fabr.
H. nimbatus Say.
sublævis *Lec.* Proc. Acad. Nat. Sc. VII, 368.
glaber *Herbst.*

Philhydrus Solier.

nebulosus *Lec.*
Hydrophilus nebulosus Say.
diffusus *Lec.* Proc. Acad. Nat. Sc. VII, 371.
perplexus *Lec.* ibid.
cinctus *Lec.*
Hydrophilus cinctus Say.
Philhydrus limbalis Mels.

Hydrobius Leach.

subcupreus *Lec.*
Hydrophilus subcupreus Say.

STAPHYLINIDÆ.[1]

Falagria Mann.

venustula *Er.*

Xantholinus Dahl.

obscurus *Er.*

Staphylinus Linn.

villosus *Grav.*
cinnamopterus *Grav.*

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[1] Besides the described species of this family mentioned above, nondescripts of the following genera are contained in my collection, but the description of them at present would be attended with no advantage to science, on account of the multitude of other species that remain unknown: they must therefore await the monographing of the entire group.

Myrmedonia, Homalota, Tachyusa, Conurus, Tachinus, Boletobius, Philonthus, Acylophorus, Quedius, Lathrobium, Stenus, Bledius, Oxytelus, Trogophlœus, Apocellus, Boreaphilus, Omalium.

Philonthus Leach.

hepaticus *Er.*

Acylophorus Nordm.

flavicollis *Sachse.*

Sunius Leach.

longiusculus *Er.*
Pæderus longiusculus Mann.
Pæderus discopunctatus Say:
? binotatus *Say* (Pæderus), (fide Say).

Pæderus Fabr.

littorarius *Grav.*

Lithocharis Er.

confluens *Er.*
Lathrobium confluentum Say.

Stenus Latr.

egenus *Er.*
flavicornis *Er.*
punctatus *Er.*

Euæsthetus Grav.

americanus *Er.*

Bledius Leach.

pallipennis *Er.* (fide Say).
Oxytelus pallipennis Say.
armatus *Er.* (fide Say).
Oxytelus armatus Say.
melanocephalus *Er.* (fide Say).
Oxytelus melanocephalus Say.
fasciatus *Er.* (fide Say).
Oxytelus fasciatus Say.

Osorius Leach.

latipes *Er.*

Anthophagus Grav.

brunneus *Say.*

Glyptoma Er.

costale *Er.*

PSELAPHIDÆ.

Tyrus Aubé.

humeralis *Lec.*
Hamotus humeralis Aubé, teste Schaum.
Tyrus compar Lec.

Bryaxis Leach.

rubicunda *Aubé.*

SILPHIDÆ.

Necrophorus Fabr.

mediatus *Fabr.*
marginatus *Fabr.*
Melsheimeri *Kirby.*
pustulatus *Herschel.*
N. bicolon Newman.
orbicollis *Say.*
N. Hallii Kirby.
velutinus *Fabr.*
N. tomentosus Weber.

Silpha Linn.

surinamensis *Fabr.*
lapponica *Herbst.*
Silpha caudata Say.
Silpha tuberculata Germ.
Silpha californica Mann.
Oiceoptoma granigera Chevr.
truncata *Say.*
peltata *Lec.* Proc. Acad. Nat. Sc. VI, 279.
Searabæus peltatus Catesby.
Silpha americana Linn.
ramosa *Say.*
bituberosa *Lec.*, ante, 6.

Catops Fabr.

simplex *Say* (fide Say).
basillaris *Say* (fide Say).

Agathidium Illiger.

exiguum *Mels.*
A. rufieorne Lec.
? pallidum *Say* (fide Say).

PHALACRIDÆ.

Phalacrus Payk.

penicillatus *Say.*
seriatus *Lec.* Proc. Acad. Nat. Sc. VIII, 15.
simplex *Lec.* ibid.

Olibrus Er.

pallipes *Lec.* Proc. Acad. Nat. Sc. VIII, 17.
Phalaerus pallipes Say.
striatulus *Lec.* Proc. Acad. Nat. Sc. VIII, 16.
semistriatus *Lec.* ibid.

NITIDULIDÆ.

Carpophilus Leach.

caudalis Lec. Proc. Acad. Nat. Sc. 1859, 70.
apicalis *Lec.* ante, 6.

carbonatus *Lec.*, ante, 6.
pallipennis *Lec.*
Cercus pallipennis Say.
Carpophilus floralis Er.

Epuræa Er.

rufa *Er.*
Nitidula rufa Say.

Nitidula Fabr. (emend. Er.)

ziczac *Say.*
uniguttata *Mels.*

Omosita Er.

colon *Er.*
Nitidula colon Fabr.

Phenolia Er.

grossa *Er.*
Nitidula grossa Fabr.

Meligethes Steph.

ruficornis *Lec.*, ante, 6.
sævus *Lec.*, ante, 6.

Pocadius Er.

helvolus *Er.*

Pallodes Er.

silaceus *Er.*

Cryptarcha Er.

strigata *Er.*
Nitidula strigata Fabr.

Ips Fabr.

sanguinolentus *Oliv.*
quadrisignatus *Say.*
bipunctatus *Say.*
Colydium bipunctatum Say.

Trogosita Oliv.

castanea *Mels.*
corticalis *Mels.*

LATHRIDIIDÆ.

Lathridius Herbst.

? 8-dentatus *Say* (fide Say).
? *Corticaria denticulata* Kirby.

COLYDIIDÆ.

Bothrideres Er.

geminatus *Er.* (nec *Hald.*)
Lyctus geminatus Say.

Cerylon Latr.

castaneum *Say.*
unicolor *Lec.*
Lathridius unicolor Ziegler.

CUCUJIDÆ.

Læmophlœus Er.

biguttatus *Mels.*
Cucujus biguttatus Say.
Læmophlœus bisignatus Guér.

Brontes Fabr.

dubius *Fabr.*

Silvanus Latr.

planatus *Germ.*
dentatus *Say.*
Lyctus dentatus Fabr.

DERMESTIDÆ.

Dermestes Linn.

marmoratus *Say.*
nubilus *Say.*
caninus *Germ.*
elongatus *Lec.*
vulpinus *Fabr.*

HETEROCERIDÆ.

Heterocerus Fabr.

pallidus *Say* (fide Say).
pusillus *Say* (fide Say).

GEORYSSIDÆ.

Georyssus Latr.

pusillus *Lec.* Proc. Acad. Nat. Sc. VI, 44.

SCAPHIDIIDÆ.

Scaphidium Oliv.

4-pustulatum *Say.*

HISTERIDÆ.

Hololepta Payk.

fossularis *Say.*
æqualis Say (fem.)
lucida *Lec.*

Hister Linn.

instratus *Lec.*, ante, 7.
biplagiatus *Lec.*
dispar *Lec.*
depurator *Say.*
abbreviatus Fabr.
nubilus *Lec.*, ante, 7.
pollutus *Lec.*, ante, 7.
americanus *Payk.*
subrotundus *Er.*
carolinus *Payk.*
Lecontei *Lec.*
Platysoma depressum‡Er., Lec.
Platysoma Lecontei Marseul.
parallelus *Say.*

Paromalus Er.

æqualis *Er.*
Hister æqualis Say.
bistriatus *Er.*

Saprinus Leach.

lugens *Er.*
californicus Mann.
spurcus *Lec.*, ante, 7.
parumpunctatus *Lec.*, ante, 7.
pratensis *Lec.*, ante, 8.
pensylvanicus *Er.*
Hister pensylvanicus Payk.
patruelis *Lec.*

Plegaderus Leach.

transversus *Lec.*
Hister transversus Say.

Acritus Lec.

exiguus *Lec.*
Abræus exiguus Er.

SCARABÆIDÆ.

Xyloryctes Hope.

satyrus *Burm.*
Geotrupes satyrus Fabr.

Phileurus Latr.

valgus *Dej.*
Geotrupes valgus Fabr.
Phileurus castaneus Hald.

Strategus Hope.

mormon *Burm.*

Aphonus Lec.

pyriformis *Lec.* Proc. Acad. Nat. Sc. VIII, 21.
Bothynus pyriformis Lec.
tridentatus *Lec.* ibid. VIII, 22.
Scarabæus tridentatus Say.
Bothynus tridentatus Lec.

Ligyrus Burm.

gibbosus *Lec.* Proc. Acad. Nat. Sc. VIII, 20.
Scarabæus gibbosus DeGeer.
Podalgus variolosus Burm.
relictus *Lec.* Proc. Acad. Nat. Sc. VIII, 21.
Searabæus relictus Say.
Heteronychus relictus Burm.

Osmoderma Lepell.

eremicola *Gory.*
Cetonia eremicola Knoch.

Cremastochilus Knoch.

nitens *Lec.* Proc. Acad. Nat. Sc. VI, 232.
Knochii *Lec.* ibid. VI, 231.
saucius *Lec.* Journ. Acad. Nat. Sc. 2d ser. IV, 16.

Euryomia Burm. (emend. Lac.)

inda *Lac.* Gen. Col. III, 528.
Scarabæus indus Linn.
Cetonia barbata Say.
Erirhipis inda Burm.
melancholica *Lac.* Gen. Col. III, 527.
Cetonia melancholica Gory.
Euphoria melancholica Schaum.
sepulchralis *Lac.* ibid.
Cetonia sepulchralis Fabr.
Cetonia Reichii Gory.
Euphoria sepulchralis Burm.
fulgida *Lac.* Gen. Col. III, 528.
Cetonia fulgida Fabr.
Erirhipis fulgida Fabr.
areata *Lac.* Gen. Col. III, 528.
Cetonia areata Fabr.
Stephanucha areata Burm.

Allorhina Burm. (emend. Lac.)

nitida *Lac.* Gen. Col. III, 497.
Scarbæus nitidus Linn.
Cotinis nitida Burm.

Anomala Samouelle (emend. Burm.).

minuta *Burm.*
marginata *Burm.*
Melolontha marginata Fabr.
Melolontha annulata Germ.
varians *Burm.*
Melolontha varians Fabr.

Strigoderma Burm.

arboricola Burm.
Melolontha arboricola Fabr.

Polyphylla Harris.

decemlineata *Lec.* (infra).
Melolontha 10-*lineata* Say.
Hammondi *Lec.* J. Ac. Nat. Sc. 2d ser. III, 228.

Lachnosterna Hope.

lanceolata *Lec.* J. Ac. Nat. Sc. 2d ser. III, 237.
Melolontha lanceolata Say.
Tostegoptera lanceolata Blanchard.
frontalis *Lec.* J. Ac. Nat. Sc. 2d ser. III, 239.
longitarsis *Lec.* ibid.
Melolontha longitarsis Say.
futilis *Lec.*
fusca *Lec.* Journ. Acad. Nat. Sc. 2d ser. III, 244.
Melolontha fusca Fröhl.
Melolontha quercina Knoch.
Melolontha fervens Gyll.
Melolontha fervida‡Oliv.
cephalica *Lec.* J. Ac. Nat. Sc. 2d ser. III, 245.
fraterna *Lec.* ibid. III, 249.
Phyllophaga fraterna Harris.
Ancylonycha fraterna Blanch.
rugosa *Lec.* ibid. III, 252.
Ancylonycha rugosa Mels.
affinis *Lec.* ibid. III, 252.
ciliata *Lec.* ibid. III, 253.
hirticula *Hope.*
Melolontha hirticula Knoch.
Melolontha hirsuta‡Say.
robusta *Lec.* ibid. III, 257.
crenulata *Lec.* ibid. III, 258.
Melolontha crenulata Fröhl.
Melolontha georgicana Gyll.
Phyllophaga georgicana Harris.
Ancylonycha crenulata Blanch.
glabricula *Lec.* ibid. III, 260.
tristis *Lec.* ibid. III, 261.
Melolontha tristis Fabr.
Melolontha pilosicollis Knoch.
Trichesthes pilosicollis Er.
Trichestes tristis Burm.

Listrochelus Blanch.

obtusus *Lec.* Journ. Acad. Nat. Sc. 2d ser. III, 264.
falsus *Lec.* ibid.
fimbripes *Lec.* ibid.

Diplotaxis Kirby.

obscura *Lec.*, ante, 9.
Harperi *Blanch.*
frondicola *Lec.*
Melolontha frondicola Say.
Diplotaxis testacea Burm.
truncatula *Lec.* J. Ac. Nat. Sc. 2d ser. III, 269.
morula *Lec.* ibid. III, 270.
Haydenii *Lec.* ibid. III, 272.
innoxia *Lec.* ibid. III, 273.

Diazus Lec.

rudis *Lec.*, ante, 10.

Dichelonycha Kirby.

truncata *Lec.* J. Ac. Nat. Sc. 2d ser. III, 281.

Serica M'Leay.

vespertina *Dej.*
Melolontha vespertina Gyll. Say.
Camptorhina atricapilla Kirby.
sericea Burm.
Melolontha sericea Say.
curvata *Lec.* J. Ac. Nat. Sc. 2d ser. III, 276.

Macrodactylus Latr.

angustatus *Lec.* J. Ac. Nat. Sc. 2d ser. III, 278.
Melolontha elongata‖Herbst.
Melolontha angustata Beauv.
Macrodactylus polyphagus Burm.

Hoplia Illiger.

laticollis *Lec.* J. Ac. Nat. Sc. 2d ser. III, 284.

Geotrupes Latr.

opacus *Hald.* Proc. Acad. Nat. Sc. 2d ser. VI, 362.

Odontæus Klug.

filicornis *Say.*
Geotrupes filicornis Say.

Bolbocerus Kirby.

lazarus *Klug.*
Geotrupes lazarus Fabr.
Geotrupes melibœus Fabr.

Canthon Hoffmans.

lævis *Mels.*
Scarabæus pilularius‖De Geer.
Scarabæus lævis Drury.
Ateuchus volvens Fabr.
chalcites *Mels.*
Coprobius chalcites Hald.
ebenus *Mels.*
Ateuchus ebenus Say.
nigricornis *Mels.*
Ateuchus nigricornis Say.
praticola *Lec.*, ante, 10.

viridis *Mels.*
Ateuchus viridis Beauv.
Onthophagus viridicatus Say.
Ateuchus obsoletus Say.

Onthophagus Latr.

orpheus.
Scarabæus orpheus Panzer.
Copris canadensis Fabr.
Hecate.
Scarabæus Hecate Panzer.
Copris latebrosus Fabr.
Copris hastator Fabr.
Copris obtectus Beauv.

Phanæus M'Leay.

carnifex *M'Leay.*
Scarabæus carnifex Linn.
triangularis *Lec.*
Copris triangularis Say.
Phanæus torrens Lec.

Copris Geoffr.

anaglypticus *Say.*
ammon *Fabr.*

Ochodæus Latr.

musculus *Lec.*
Bolboœrus musculus Say.
Ochodæus americanus Westwood.

Aphodius Illiger.

denticulatus *Hald.*
curtus *Hald.*
granarius *Illiger.*
Scarabæus granarius Linn.
Aphodius 4-tuberculatus Fabr.
vittatus *Say.*
femoralis *Say.*
concavus *Say.*
A. lævigatus Hald.
oblongus *Say.*
A. badipes Mels.

Euparia Lep. (emend. Er.)

stercorator *Er.*
Aphodius stercorator Fabr.
strigata *Lec.*
Aphodius strigatus Say.

Trox Fabr.

alternans *Lec.* Proc. Acad. Nat. Sc. VII, 211.
tuberculatus *Ol.*
Scarabæus tuberculatus DeG.
Trox canaliculatus Say.
Trox serrulatus Beauv.
sordidus *Lec.* ibid VII, 211.
capillaris *Say.*
atrox *Lec.* Proc. Acad. Nat. Sc. VII, 214.

Omorgus Er.

scutellaris *Lec.* Proc. Acad. Nat. Sc. VII, 214.
Trox scutellaris Say.
pustulatus *Lec.*
Trox tuberculatus‡Beauv.
punctatus *Lec.* Proc. Acad. Nat. Sc. VII, 215.
Trox punctatus Germ.
Trox alternatus Say.
crinaceus *Lec.*
morsus *Lec.* ibid. VII, 216.

Lucanus Linn.

capreolus *Linn.*
L. dama Thunberg.
placidus *Say.*
L. lentus Lap. Hist. Nat. II, 171.

Dorcus M'Leay.

parallelus *Burm.*
Lucanus parallelus Say.

Platycerus Geoffr.

quercus *Schönh.*
Lucanus quercus Weber.
Platycerus securidens Say.

BUPRESTIDÆ.

Ancylochira Esch.

confluens *Lec.*
Buprestis confluenta Say.
maculiventris *Lec.*
Buprestis maculiventris Say.
Buprestis sexnotata Lap.
Anoplis rusticorum Kirby.

Chalcophora Sol.

campestris *Lec.* (fide Say).
Buprestis campestris Say.
Buprestis substrigosa Lap. & Gory.

Melanophila Esch.

longipes *Lec.*
Apatura appendiculata‡Lap. & Gory.
Bup. (Oxypteris) appendiculata‡Kirby.
Melanophila immaculata Gory.
atropurpurea *Lec.*
Buprestis atropurpurea Say.

fulvoguttata *Lec.*
Buprestis fulvoguttata Harris.
Apatura octospilota Lap. & Gory.
Apatura croccosignata Lap. & Gory.
Apatura decolorata Lap. & Gory.

Anthaxia Esch.

quercata *Dej.*
Buprestis quercata Fabr.
viridicornis *Dej.*
Buprestis viridicornis Say.

Chrysobothris Esch.

sexguttata *Lec.*
Buprestis sexguttata Say.

Psiloptera Sol.

Woodhousei *Lec.*
Dicerca? Woodhousei Lec. Proc. Acad. Nat. Sc. VI, 68.
var. *P. valens* Lec. ibid. 1858, 66.

Dicerca Esch.

prolongata *Lec.*

Poecilonota Esch.

cyanipes *Lec.*
Buprestis cyanipes Say.

Acmæodera Esch.

mixta *Lec.* Trans. Am. Phil. Soc. XI, 227.

Ptosima Serv.

gibbicollis *Lec.*
Buprestis gibbicollis Say.
Ptosima luctuosa Gory.

Agrilus Lap.

bilineatus *Say.*
Buprestis bilineata Weber.
Agrilus bivittatus Kirby.
Agrilus flavolineatus Mann.
Agrilus aurolineatus Gory.
latebrus *Lap.*
granulatus *Say.*
politus *Say.*
defectus *Lec.* Trans. Am. Phil. Soc. XI, 244.
pusillus *Say.*
obolinus *Lec.* Trans. Am. Phil. Soc. XI, 248.
otiosus *Say.*
lateralis *Say.*

Brachys Sol.

terminans *Lap.*
Buprestis terminans Fabr.

ELATERIDÆ.

Tharops Lap.

ruficornis *Lec.* Trans. Am. Phil. Soc. X, 411.
Melasis ruficornis Say.

Hylochares Latr.

nigricornis *Lec.* Trans. Am. Phil. Soc. X, 413.
Melasis nigricornis Say.

Microrhagus Esch.

triangularis *Lec.* Trans. Am. Phil. Soc. X, 419.
Elater triangularis Say.

Pedetes Kirby.

cucullatus *Lec.* Trans. Am. Phil. Soc. X, 425.
Elater cucullatus Say.
Athous hypoleucus Mels.
Athous procericollis Mels.
Athous strigatus Mels.

Limonius Esch.

auripilis *Lec.* Trans. Am. Phil. Soc. X, 429.
Elater auripilis Say.
quercinus *Dej.*
Elater quercinus Say.
basillaris *Lec.* Trans. Am. Phil. Soc. X, 431.
Elater basillaris Say.

Cratonychus Er.

macer *Lec.* Trans. Am. Phil. Soc. X, 473.
incertus *Lec.* Trans. Am. Phil. Soc. X, 474.
clandestinus *Er.*
fissilis *Lec.*
Cratonychus laticollis Er.
?Elater brevicollis Herbst.
Elater cinereus (*fissilis*) Say.
Elater (*Melanotus*) *cinereus* Harris.
Cratonychus ochraceipennis Mels.
Cratonychus sphenoidalis Mels.
communis *Er.*
Elater communis Gyll.
Elater cinereus Weber.
cribulosus *Lec.* Trans. Am. Phil. Soc. X, 478.

Monocrepidius Esch.

vespertinus *Dej.*
Elater vespertinus Fabr.
Elater finitimus Say.
Monocrepidius serotinus Germ.
auritus *Germ.*
Elater auritus Herbst.
Oophorus crassicollis Mels
bellus *Dej.*
Elater bellus Say.
Cryptohypnus bellus Germ.

Æolus Esch.

dorsalis *Candèze*, Mon. Elat. II, 285.
Elater dorsalis Say.
Cryptohypnus dorsalis Germ.

Œdostethus Lec.

femoralis *Lec.* Trans. Am. Phil. Soc. X, 489.

Adelocera Latr.

impressicollis *Lec.* Trans. Am. Phil. Soc. X, 490.
Elater impressicollis Say.
Elater lepturus Say.
Adelocera senilis Germ.
marmorata *Germ.*
Elater marmoratus Fabr.

Lacon Lap.

rectangularis *Candèze*, Mon. El. I, 155.
Elater rectangularis Say.

Melanactes Lec.

piceus *Lec.* Trans. Am. Phil. Soc. X, 494.
Elater piceus DeGeer.
Elater lævigatus Fabr.
Elater morio (var.) Say.
Pristilophus lævigatus Germ.
Pristilophus femoralis Mels.
puncticollis *Lec.* Trans. Am. Phil. Soc. X, 495.
Pristilophus puncticollis Lec. Proc. Ac. Nat. Sc. VI, 68.

Alaus Esch.

oculatus *Esch.*
Elater oculatus Fabr.
myops *Esch.*
Elater myops Fabr.
Elater luscus‡Oliv.
gorgops *Lec.* Journ. Acad. Nat. Sc. 2d ser. IV, 35.
Alaus oculatus (var.) Lec. Trans. Am. Phil. Soc. 10, 496.

Cardiophorus Esch.

erythropus *Er.*
Cardiophorus amictus Mels.
?*Elater convexus* Say.

CYPHONIDÆ.

Helodes Latr.

ruficollis *Lec.*
Lampyris ruficollis Say.
Elodes fragilis Ziegler.

Scirtes Illiger.

centralis *Lec.*
Altica centralis Say.
? Scirtes orbiculatus Fabr.
Scirtes suturalis‖Ziegler.
Scirtes lateralis Lec.

LYCIDÆ.

Calopteron Lap.

typicum *Lec.*
Digrapha typica Newm.
Digrapha discrepans Newm.
Digrapha affinis Lec.
terminale *Lec.*
Lycus terminalis Say.

Temnostoma Guér.

sanguinipennis *Lec.*
Lycus sanguinipennis Say.

LAMPYRIDÆ.

Photinus Lap. (emend. Lac.)

§ **Ellychnia** Lec.

nigricans *Lec.*
Lampyris nigricans Say.
? Lampyris obscura Fabr.
corrusca *Lec.*
Lampyris corrusca Linn,

§§ **Photinus** Lap.

pyralis *Lap.*
Lampyris pyralis Linn.
Lampyris centrata Say.
Lampyris rosata Germ.
marginella *Lec.*
punctulata *Lec.*
obscurella *Lec.*

Photuris Lec.

pensylvanica *Lec.*
Lampyris pensylvanica DeGeer.
Lampyris versicolor Fabr.
divisa Lec.

TELEPHORIDÆ.

Chauliognathus Hentz.

marginatus *Hentz.*
Cantharis marginata Fabr.
Cantharis ligata Say.
basalis *Lec.*, ante, 13.

Telephorus Geoffr.

collaris *Lec.*
bilineatus *Lec.*
Cantharis bilineatus Say.
jactatus *Lec.*
Cantharis jactata Say.
carolinus.
Cantharis carolina Fabr.
luteicollis *Germ.*
T. cinctellus Lec.
dichrous *Lec.*
flavipes *Lec.*

Podabrus Fischer.

rugosulus *Lec.*
punctulatus *Lec.*

Trypherus Lec.

latipennis *Lec.*
Malthinus latipennis Germ.
Molorchus marginalis Say.
Malthinus marginalis Say.
Lygerus latipennis Kiesenwetter.

MELYRIDÆ.

Collops Er.

bipunctatus *Er.*
Malachius bipunctatus Say.
tricolor *Er.*
Malachius tricolor Say.
punctatus *Lec.* Proc. Acad. Nat. Sc. VI, 164.
quadrimaculatus *Er.*
Malachius 4-maculatus Fabr.
confluens *Lec.* Proc. Acad. Nat. Sc. VI, 164.
punctulatus *Lec.* ibid.

Ebæus Er.

morulus *Lec.* Proc. Acad. Nat. Sc. VI, 167.

Dasytes Fabr.

senilis *Lec.* Proc. Acad. Nat. Sc. VI, 170.

Byturus Fabr.

unicolor *Say.*

CLERIDÆ.

Cymatodera Gray.

undulata *Lec.*
Tillus undulatus Say.
Cymatodera longicollis Spin.
Cymatodera Bosci Chevr.

Trichodes Herbst.

ornatus *Say.*
Nuttalli *Kirby.*

Clerus Geoffr.

analis *Say.*
cordifer *Lec.*
sphegeus *Fabr.*

Hydnocera Newm.

humeralis *Newman.*
Clerus humeralis Germ.

Enoplium Latr.

pilosum *Latr.*
Lampyris pilosa Forster.
var. *Enoplium onustum* Say
Enoplium marginatum‖Say.
quadripunctatum *Say.*

Orthopleura Spin.

damicornis *Spin.*
Tillus damicornis Fabr.
Enoplium thoracicum Say.

Corynetes Fabr.

rufipes *Fabr.*
violaceus *Fabr.*

PTINIDÆ.

Dorcatoma Herbst.

simile *Say.*

BOSTRICHIDÆ

Bostrichus Geoffr. (emend. Lac.)

bicaudatus *Lec.*
Apate bicaudatus Say.

TENEBRIONIDÆ.

Epitragus Latr.

canaliculatus *Say.*

Edrotes Lec.

rotundus *Lec.*
Pimelia rotunda Say.

Trimytis Lec.

pruinosa *Lec.*

Pelecyphorus Sol.

sordidus *Lec.* Proc. Acad. Nat. Sc. VI, 446.

Euschides Lec.

convexa *Lec.*, ante, 14.
polita *Lec.*
Asida polita Say.

Asida Latr.

opaca *Say.*

Pactostoma Lec.

anastomosis *Lec.* J. Ac. Nat. Sc. 2d ser. IV, 19.
Asida anastomosis Say.
Ologlyptus anastomosis Lac.

Eleodes Esch.

obscura *Lec.*
Blaps obscura Say.
? *Blaps hispilabris* Say.
dispersa *Lec.* Proc. Acad. Nat. Sc. 1858, 182.
acuta *Lec.*
Blaps acuta Say.
suturalis *Lec.*
Blaps suturalis Say.
tricostata *Lec.*
Blaps tricostata Say.
Pimelia alternata Kirby.
sulcata *Lec.* Proc. Acad. Nat. Sc. VI, 67.
obsoleta *Lec.*
Blaps obsoleta Say.
fusiformis *Lec.* Proc. Acad. Nat. Sc. 1858, 184.
extricata *Lec.*
Blaps extricata Say.
carbonaria *Lec.*
Blaps carbonaria Say.
nigrina *Lec.* Proc. Acad. Nat. Sc. 1858, 186.
Haydenii *Lec.* ibid. 1858, 186.
viator *Lec.* ibid. 1858, 188.

Promus Lec.

opacus *Lec.* Say's Ent. Writings, II, 155.
Blaps opaca Say.

Embaphion Say.

muricatum *Say* (Akis).
contusum *Lec.* Journ. Acad. Nat. Sc. 2d ser. IV, 40.

Coniontis Esch.

obesa *Lec.*

Eusattus Lec.

reticulatus *Lec.*
Zophosis reticulata Say.
convexus *Lec.*

Pedinus Latr.

? suturalis *Say* (fide Say).

Blapstinus Waterhouse.

interruptus *Lec.*
Opatrum interruptum Say.
Blapstinus æneolus Mels.
pratensis *Lec.*, ante, 15.
vestitus *Lec.*, ante, 15.

Centronopus Sol.

opacus *Lec.*, ante, 15.

Upis Fabr.

lævis *Oliv.*

Nyctobates Esch.

pensylvanicus *Lec.*
Tenebrio pensylvanicus DeGeer.
Upis chrysops Herbst.
barbatus *Lec.*
Upis barbatus Kuoch.

Boletophagus Illiger.

? cornutus *Fabr.*
Opatrum cornutum Panz.
Opatrum bifurcum Fabr.

Uloma Redt.

culinaris *Redt.*
Tenebrio culinaris Linn.

Tenebrio Linn.

tenebrioides *Lec.*
Helops tenebrioides Beauv.
Tenebrio badipes Mels.

Paratenetus Spin.

punctatus *Spin.*

Adelina Dej.

pallida *Lec.*
Pytho pallida Say.

Diaperis Geoffr.

hydni *Fabr.*

Platydema Lap.

excavatum *Lap.*

Allecula Fabr.

punctulata *Mels.*
obscura *Say.*

MELANDRYADÆ.

Eustrophus Fabr.

bicolor *Fabr.*

Melandrya Fabr.

labiata *Say.*

PEDILIDÆ.

Scraptia Latr.

plagiata *Mels.*
S. americana Hald.

Stereopalpus Fertè.

guttatus *Lec.* Proc. Acad. Nat Sc. VII, 271.

ANTHICIDÆ.

Notoxus Geoffr.

anchora *Hentz.*
serratus *Lec.*
monodon *Ferté.*
Anthicus monodon Fabr.
marginatus *Lec.*
subtilis *Lec.*

Anthicus Payk.

elegans *Fertè.*
rejectus *Lec.*
cervinus *Fertè.*
A. bifasciatus‖Say.
A. terminalis Lec.
A. bizonatus Fertè.

MORDELLIDÆ.

Mordella Fabr.

quadripunctata *Lec.*
Anaspis 4-punctata Say.
insulata *Lec.*, ante, 16.
marginata *Mels.*

Mordellistena Costa.

æmula *Lec.*, ante, 16.
divisa *Lec.*, ante, 17.

RHIPIPHORIDÆ.

Emenadia Lap.

Sayi *Lec.*
Rhipiphorus bicolor‖Say.
limbatus *Lac.*
Rhipiphorus limbatus Fabr.
pectinatus *Lec.*
Rhipiphorus pectinatus Fabr.
Rhipiphorus varicolor Gerst.

Myodites Latr.

scaber *Lec.* Proc. Acad. Nat. Sc. VI, 67.

MELOIDÆ.

Henous Hald.

confertus *Lec.* Proc. Acad. Nat. Sc. VI, 330.
Meloe conferta Say.
Henous techanus Hald.

Lytta Fabr.

reticulata *Say.*
Nuttalli *Say.*
var. *Cantharis fulgifer* Lec.
sphæricollis *Say.*
Engelmanni *Lec.* Proc. Acad. Nat. Sc. VI, 337.
Pyrota Engelmanni Lec.
discoidea *Lec.* Proc. Acad. Nat. Sc. VI, 338.
pensylvanica *Lec.* ibid. VI, 339.
Cantharis pensylvanica DeGeer.
Lytta atrata Fabr.
ferruginea *Say.*
maculata *Say.*
conspersa *Lec.* Proc. Acad. Nat. Sc. VI, 340.
segmentata *Say* (segmenta).
albida *Say.*
L. luteicornis Lec.
immaculata *Say.*
♂ *L. articularis* Say.
longicollis *Lec.* Proc. Acad. Nat. Sc. VI, 343.
Fabricii *Lec.* ibid.
L. cinerea‖Fabr.

Nemognatha Illiger.

bicolor *Lec.* Proc. Acad. Nat. Sc. VI, 345.
lurida *Lec.* ibid.
lutea *Lec.* ibid. VI, 346.
piezata *Lec.* ibid. VI, 347.
Zonitis piezata Weber, Fabr.
Zonitis vittata Fabr.
immaculata *Say.*
minima *Say.*

Zonitis Fabr.

atripennis *Lec.* Proc. Acad. Nat. Sc. VI, 349.
Nemognatha atripennis Say.

ŒDEMERIDÆ.

Asclera Schmidt.

puncticollis *Hald.*
Œdemera puncticollis Say.

ruficollis *Hald.*
Œdemera ruficollis Say.
? vestita *Say* (Œdemera), fide Say.
(an potius Stereopalpus.)

CURCULIONIDÆ.

Bruchus Linn.

discoideus *Say.*
and five others.

Spermophagus Steven.

Robiniæ *Sch.*
Bruchus Robiniæ Fabr.

Cratoparis Sch.

lunatus *Sch.*
Anthribus lunatus Fabr.
Anthribus marmoreus Ol.

Attelabus Linn.

nigripes *Lec.*

Pterocolus Schönh.

ovatus *Schönh.*
Attelabus ovatus Fabr.

Rhynchites Herbst.

bicolor *Herbst.*
Attelabus bicolor Fabr.
æneus *Boheman.*
æratus *Say.*

Apion Herbst.

four species.

Ophryastes Schönh.

latirostris *Lec.* Proc. Acad. Nat. Sc. VI, 443.
ligatus *Lec.* ibid.
sulcirostris *Schönh.*
Liparus sulcirostris Say.
vittatus *Schönh.* (infra).
Liparus vittatus Say.

Epicærus Schönh.

? imbricatus (fide Say).
Liparus imbricatus Say.
and four species? with four others of allied genera.

Platyomus Schönh.

auriceps *Schönh.*
Curculio auricephalus Say.

Thylacites Germ.

microsus *Schönh.*
T. microps Say.

Tanymecus Germ.

canescens *Schönh.*
confertus *Schönh.*
T. confusus Say.

Cleonus Schönh.

pulvereus *Lec.*, ante, 18.
trivittatus *Say.*
angularis *Lec.*, ante, 18.

Listroderes Schönh.

three species.

Lepyrus Germ.

geminatus *Say.*

Lithodus Germ.

humeralis *Germ.*
Brachycerus humeralis Say.
Thecesternus humeralis Say.
rectus *Lec.* Proc. Acad. Nat. Sc. VIII, 18.
affinis *Lec.* Proc. Acad. Nat. Sc. VIII, 18.
rudis *Lec.* Proc. Acad. Nat. Sc. VIII, 18.
erosus *Lec.* Proc. Acad. Nat. Sc. VIII, 18.
longior *Lec.* Proc. Acad. Nat. Sc. VIII, 19.
morbillosus *Lec.* Proc. Acad. Nat. Sc. VIII, 19.

Lixus Fabr.

two species.

Erirhinus Schönh.

and allied genera 15 species.

Grypidius Schönh.

one species.

Balaninus Germ.

one species.

Piazorhinus Schönh.

scutellaris *Schönh.* Curc. III, 472; VII, 2, 352.
Attelabus scutellaris Say.

Baridius Schönh.

seven species.

Centrinus Schönh.

two species.

Ceuthorhynchus Schüppel.

four species.

Rhyssematus Schönh.

lineaticollis *Schönh.*
Rhynchænus lineaticollis Say.

Acalles Schönh.

three species.

Conotrachelus Latr.

posticatus *Schönh.*

Sphenophorus Schönh.

pulchellus *Schönh.*
cultirostris *Germ.*
compressirostris *Say.* (Calandra).
and seven others.

Cossonus Clairv.

subareatus *Schönh.*
and one other species.

Tomicus Latr.

pini *Harris.*
Bostrichus pini Say.
caligraphus *Germ.*
Bostrichus cæsus Say.

CERAMBYCIDÆ.

Mallodon Serv.

dasystomus *Hald.*
Prionus dasystomus Say.
ciliipes *Hald.*
Prionus ciliipes Say.

Prionus Geoffr.

palparis *Say.*
imbricornis *Oliv.*
fissicornis *Hald.*
integer *Lec.*
emarginatus *Say.*

Criocephalus Muls.

productus *Lec.*
asperatus *Lec.*, ante, 19.
agrestis *Hald.*
Callidium agreste Kirby.

Semanotus Muls.

brevilineus *Lec.*
Callidium brevilineum Say.
Physocnemum brevilineum Hald.

Callidium Fabr.

variabile *Fabr.*
amœnum *Say.*

Dryobius Lec.

sexfasciatus *Lec.*
Callidium sexfasciatum Say.

Heliomanes Newman.

bimaculatus *Newman.*
Molorchus bimaculatus Say.
Molorchus affinis Lec.
Heliomanes obscurus Lec. (err. typog.)

Eburia Serv.

quadrigeminata *Hald.*
Stenocorus quadrigeminatus Say.

Elaphidion Serv.

simplicicolle *Hald.*
E. pulverulentum‡Hald.
mucronatum *Newman.*
Stenocorus mucronatus Say.
villosum *Dej.*
Stenocorus villosus Fabr.
Stenocorus putator Peek.

Eriphus Serv.

ignicollis *Lec.*
Callidium ignicolle Say.
Callidium sanguinicolle Germ.

Arhopalus Serv. (emend. Lec.)

fulminans *Serv.*
Clytus fulminans Fabr.
charus *Lec.*
Clytus charus Say.
pictus *Lec.*
Cerambyx pictus Drury.
Leptura Robiniæ Forster.
Clytus flexuosus Fabr.

Rhopalophorus Serv.

longipes *Lec.*
Stenocorus longipes Say.
Tinopus longipes Lec.

Purpuricenus Serv.

humeralis *Dej.*
Cerambyx humeralis Fabr.

Clytus Fabr.

scutellaris *Dej.*
Callidium scutellare Oliv.
erythrocephalus *Fabr.*
undulatus *Say.*
C. Sayi Lap.
C. undatus Kirby.
capræa *Say.*
C. clevatus Lap.

Acmæops Lec.

bivittata *Lec.*
Leptura bivittata Say.
dorsalis *Lec.*, ante, 21.

Typocerus Lec.

sinuatus *Lec.*
Leptura sinuata Newman.
Stenura 8-notata Hald.

Leptura Linn.

cribripennis *Lec.*, ante, 21.
rubrica *Say.*

Monilema Say.

annulatum *Say.*

Plectrodera Lec.

scalator *Lec.*
Lamia scalator Fabr.
Lamia Belli Lec.

Oberea Muls.

perspicillata *Hald.*
oculaticollis *Lec.*
Saperda oculaticollis Say.

Stenostola Muls.

pergrata *Lec.*
Saperda pergrata Say.
gentilis *Lec.*
saturnina *Lec.*, ante, 21.

Amphionycha Lec.

ardens *Lec.*, ante, 22.

Tetrops Kirby.

canescens *Lec.*

Tetraopes Dalman.

tetraophthalmus *Harris.*
Cerambyx tetraophthalmus Forster.
Lamia tornator Fabr.
femoratus *Lec.*
annulatus *Lec.*

Saperda Fabr.

calcarata *Say*
var. *S. adspersa* Lec.
mutica *Say.*
discoidea *Fabr.*
puncticollis *Say.*
S. trigeminata Randall.
?inornata *Say* (fide Say).

Pogonocherus Latr.

parvulus *Lec.*

Psenocerus Lec

supernotatus *Lec.*
Clytus supernotatus Say.

Leptostylus Lec.

aculiferus *Lec.*
Lamia aculifera Say.
Amniscus marginellus Hald.

Liopus Serv.

cinereus *Lec.*

Acanthoderes Serv.

decipiens *Lec.*
Ægomorphus deeipiens Hald.

CHRYSOMELIDÆ.

Clythra Laichart.

laticlavia *Sch.*
Chrysomela laticlavia Forster.
Clythra obsita Fabr.

Babia Lac.

quadriguttata *Lac.*
Clythra 4-guttata Oliv.

Coscinoptera Lac.

franciscana *Lec.*, ante, 22.

Cryptocephalus Geoffr.

lativittis *Germ.*
C. geminatus Hald.
guttulatus *Oliv., Suffr.*
C. lautus Newman.
mucoreus *Lec.*, ante, 23.
notatus *Oliv.*
C. quadrimaculatus Say, Hald.
quadriguttulus *Suffrian.*
dispersus *Hald.*
venustus *Fabr., Hald.*
C. ornatus Say.
C. calidus Suffr.
leucomelas *Suffrian.*
fasciatus Say.
amatus *Hald.*
confluens *Say.*
viridis *Hald.*
Monachus viridis Mels.
?Cryptocephalus auratus Fabr.

Pachybrachys Suffr.

hepaticus *Hald.*
Cryptocephalus hepaticus Mels.
tridens *Mels.*
mollis *Hald.*
viduatus *Suffr.*
Cryptocephalus viduatus Fabr.
Cryptocephalus bivittatus Say.
and four? other species.

Colaspis Fabr.

favosa *Say.*
and six? other species.

Metachroma Lec.

interruptum *Lec.*
Colaspis interrupta Say.
pallidum *Lec.*
Colaspis pallida Say.
var. *Colaspis dubiosa* Say.

Paria Lec.

sexnotata *Lec.*
Colaspis 6-notata Say.
quadrinotata *Lec.*
Colaspis 4-notata Say.
aterrima *Lec.*
Colaspis aterrima Oliv.
opacicollis *Lec.*, ante, 23.
pumila *Lec.*, ante, 23.

Heteraspis Lec.

nebulosa *Lec.*, ante, 23.
smaragdula *Lec.*, ante, 24.

Myochrous (↓ Chevr.).

denticollis *Lec.*
Colaspis denticollis Say.
squamosus *Lec.*, ante, 24.

Chrysomela Linn.

scalaris *Lec.*
philadelphica *Linn.*
multipunctata *Say.*
var. *C. verrucosa* Suffr. Ent. Zeit. 1858, 265.
exclamationis *Fabr.*
conjuncta *Rogers*, Proc. Acad. Nat. Sc. VIII, 34.
disrupta *Rogers*, ibid.
lunata *Fabr.*
C. hybrida Say.
pulchra *Fabr.*
var. *C. casta* Rogers, Pr. Ac. Nat. Sc. VIII, 33.
C. lineata DeGeer.
C. festiva Fabr.
incisa *Rogers*, Proc. Acad. Nat. Sc. VIII, 34.
præcelsa *Rogers*, Proc. Acad. Nat. Sc. VIII, 35.
auripennis *Say.*
basillaris *Say* (fide Say).
flavomarginata *Say.*
interrupta *Fabr.*
scripta *Fabr.*
obsoleta *Say.*
dissimilis *Say.*
formosa *Say.*

Doryphora Fabr.

10-lineata *Say.*
Rogersii *Lec.* Journ. Ac. Nat. Sc. 2d ser. IV, 26.
trimaculata *Say.*
Chrysomela trimaculata Linn.
Chrysomela clivicollis Fabr.

Blepharida Rogers (↓ Chevr.).

rhois *Rogers.*
Chrysomela rhois Forster.
Chrysomela stolida Fabr.
Altica virginica Fröhlich.

Œdionychis Latr.

gibbitarsa *Lec.*
A. gibbitarsa Say.
scripticollis *Lec.*
A. scripticollis Say.
lobata *Lec.*, ante, 24.

Haltica Illiger.

alternata *Illiger.*
A. quinquevittata Say.
punctigera *Lec.*, ante, 24.
pluriligata *Lec.*, ante, 25.
collaris *Illiger.*
Galleruca collaris Fabr.
cervicalis *Lec.*, ante, 25.
bimarginata *Say.*
subplicata *Lec.*, ante, 25.
punctipennis *Lec.*, ante, 25.
picta *Say.*
helxines *Illiger.*
var. *A. nana* Say.
Chrysomela helxines Linn.
erythropus *Lec.*
Crepidodera erythropus Mels.

Glyptina Lec.

spuria *Lec.*, ante, 26.
lissotorques *Lec.*, ante, 27.

Longitarsus Latr.

nigripalpis *Lec.*, ante, 26.
rubidus *Lec.*, ante, 26.

Chætocnema Steph.

denticulata *Lec.*
Haltica denticulata Illiger.
subviridis *Lec.*, ante, 27.

Cerotoma (‡ Chevr.).

caminea *Fabr.* (Galleruca.)

Diabrotica (‡ Chevr.).

thoracica *Mels.* (Calomicrus).
longicornis *Say* (Galleruca).
tricincta *Say* (Galleruca).
? atriventris *Say* (Galleruca), (fide Say).
? atripennis *Say* (Galleruca), (fide Say).

Adimonia Laich.

externa *Lec.*
Galleruca externa Say.

Galleruca Fabr.

dorsata *Say* (fide Say).
circumdata *Say* (fide Say).
and five other species.[1]

Hispa Fabr.

? collaris *Say* (fide Say).

Anoplitis Kirby.

scapularis *Lec.*
Hispa scapularis Oliv.
Hispa lateralis Say.
rosea *Lec.*
Hispa rosca Weber.
Hispa pallida Say.
Hispa Philemon Newman.

Microrhopala Chevr.

lætula *Lec.*, ante, 27.
cyanea *Lec.*
Hispa cyanea Say.
? *Hispa Hecate* Newman.

Chelymorpha Boheman.

Argus *Boh.*
Cassida Argus Herbst.
Cassida cribraria‡ Oliv.
Imatidium 17-*punctatum* Say.

Cassida Herbst.

? unipunctata *Say.*
? ellipsis *Lec.*, ante, 28.
6-punctata *Fabr.*
C. bistripustulata Herbst.
nigripes *Oliv.*
atripes *Lec.*, ante, 28.

Coptocycla Boh.

pallida *Lec.*
Cassida pallida Herbst.
? *Coptocycla aurisplendens* Mann.
cruciata *Lec.*
Cassida cruciata DeG.
Cassida guttata Oliv.
Cassida signifer Herbst.
Coptocycla guttata Boh.
purpurata *Boh.*

COCCINELLIDÆ.

Anisosticta Chevr.

vittigera *Lec.*
Hippodamia vittigera Mann.
Næmia vittigera Muls.
episcopalis *Lec.*
Coccinella episcopalis Kirby.
Næmia episcopalis Muls.

Hippodamia Chevr.

glacialis *Muls.*
Coccinella glacialis Fabr.
Coccinella abbreviata Fabr.
Coccinella remota Weber.
13-punctata *Muls.*
Coccinella 13-*punctata* Linn.
Coccinella tibialis Say.
Lecontii *Muls.*
convergens *Guér.*
Coccinella modesta Mels.
parenthesis *Lec.*
Coccinella parenthesis Say.
Coccinella tridens Kirby.
Adonia parenthesis Muls.

Coccinella Linn.

transversoguttata *Fald.*
C. 5-*notata* Kirby.
monticola *Muls.*
novemnotata *Herbst.*
abdominalis *Say.*
humeralis *Say* (fide Say).

Brachiacantha Chevr.

albifrons *Lec.*
Coccinella albifrons Say.
tau *Lec.*, ante, 28.
10-pustulata *Lec.*
Hyperaspis 10-*pustulata* Mels.

[1] These supposed species belong to the group of pubescent trivittate ones, and need more thorough investigation than can at present be made.

Hyperaspis Chevr.

vittigera *Lec.* Proc. Acad. Nat. Sc. VI, 133.
quadrivittata *Lec.* ibid. VI, 133.
elegans *Muls.*
Coccinella undulata‖Say.
prateusis *Lec.* Proc. Acad. Nat. Sc. VI, 134.

Œneis Muls.

pusilla *Lec.* Proc. Acad. Nat. Sc. VI, 135.

Scymnus Kug.

chatchas *Muls.*
S. collaris Mels.
caudalis *Lec.*
? S. creperus Muls.

Sacium Lec.

lunatum *Lec.* Proc. Acad. Nat. Sc. VI, 144.

II. OF EASTERN NEW MEXICO.

CICINDELIDÆ.

Amblychila Say.

cylindriformis *Say.**
A. Piccolominii Reiche.

Megacephala Latr.

virginica *Dej.**
Cicindela virginica Linn.
carolina *Dej.*
Cicindela carolina Linn.

Cicindela Linn.

pulchra *Say.**
purpurea *Oliv.**
var. *C. Audubonii* Lec.
obsoleta *Say.**
cinctipennis *Lec.**
cuprascens *Lec.**
guttifera *Lec.*
punctulata *Fabr.**
var. *C. micans* Fabr.
cumatilis *Lec.**
sedecimpunctata *Klug.*

CARABIDÆ.

Micrixys Lec.

distinctus *Lec.*
Panagæus distinctus Hald.
Eugnathus‖*distinctus* Lec.

Helluomorpha Lap.

laticornis *Lap.**
Helluo laticornis Dej.

Lachnophorus Dej.

elegantulus *Mann.**
Tachypus mediosignatus Ménétr.

Apristus Chaud.

subsulcatus *Lec.*
Dromius subsulcatus Dej.

Glycia Chaud.

viridicollis *Lec.**

Pristodactyla Dej.

dubia *Lec.* Proc. Acad. Nat. Sc. VII, 38.

Platynus Bon. (emend. Brullé.)

subcordatus *Lec.**
Agonum erythropum‖Kirby.
placidus *Lec.**
Feronia placida Say.
Agonum morosum Dej.

Evarthrus Lec.

substriatus *Lec.**
Feronia (*Molops*) *substriata* Lec.

Pœcilus Bon.

scitulus *Lec.**

Amara Bon.

polita *Lec.**
farcta *Lec.* Proc. Acad. Nat. Sc. VII, 353.
musculus *Say.**
Acrodon contempta Lec.
harpalina *Lec.* Proc. Acad. Nat. Sc. VII, 355.

Nothopus Lec.

zabroides *Lec.**
Euryderus‖*zabroides* Lec.
? Amara grossa Say.

Cratognathus Dej.

setosus *Lec.**
Piosoma setosum Lec.
cordatus *Lec.* Trans. Am. Phil. Soc. X, 381.

Anisodactylus Dej.

rusticus *Dej.**
Harpalus rusticus Say.
Anisodactylus pinguis Lec.
Anisodactylus crassus Lec.
Anisodactylus gravidus Lec.
Anisodactylus tristis Dej.
chalceus *Lec.*, ante, 2.

Harpalus Latr.

impotens *Lec.* Journ. Ac. Nat. Sc. 2d ser. IV, 14.
amputatus *Say.**
H. Stephensii Kirby.
rotundicollis *Kirby.**
retractus *Lec.* Journ. Ac. Nat. Sc. 2d. ser. IV, 29.
H. impiger‖Lec. Proc. Ac. Nat. Sc. VII, 79.
fallax *Lec.*, ante, 2.
desertus *Lec.*, ante, 3.
oblitus *Lec.*, ante, 2.

Stenolophus Dej.

ochropezus *Dej.**
Feronia ochropeza Say.
dissimilis *Dej.**

Dicælus Bon.

splendidus *Say.**

Chlænius Bon.

pensylvanicus *Say.**
C. vicinus Dej.
C. pubescens Harris.
laticollis *Say.**
C. diffinis Chaud.
sericeus *Say.**
Carabus sericeus Forster.
Chlænius perviridis Lec.

Pasimachus Bon.

validus *Lec.** Journ. Ac. Nat. Sc. 2d ser. IV, 14.
P. punctulatus‡Lec.
elongatus *Lec.**

Scarites Fabr.

subterraneus *Fabr.** (cum var.)

Clivina Latr.

bipustulata Dej.*
Scarites bipustulatus Fabr.
Scarites quadripustulatus Beauv.
Clivina quadripustulata Say.

Aspidoglossa Putz.

subangulata *Lec.**
Clivina crenata‡Dej.
Dyschirius subangulatus Chaud.
Dyschirius humeralis Chaud.
Aspidoglossa fraterna Putz.
Aspidoglossa vicina Putz.
Clivina bipustulata‡Say.

Bembidium Latr.

coxendix *Say.**
Odontium coxendix Lec.
dorsale *Say.**
pictum *Lec.**

Calosoma Fabr.

scrutator *Fabr.**
externum *Lec.**
Carabus externus Say.
Calosoma longipenne Dej.

DYTISCIDÆ.

Hydroporus Clairv.

striatellus *Lec.*
vilis *Lec.*

Anisomera Brullé.

cordata *Lec.*

Colymbetes Clairv.

binotatus *Harris.**
C. maculicollis Aubé.

Cybister Curtis.

fimbriolatus *White,** Brit. Mus. Cat. 5.
Dytiscus fimbriolatus Say.
Cybister dissimilis Aubé.
ellipticus *Lec.*

HYDROPHILIDÆ.

Hydrophilus Geoffr.

triangularis *Say.**
H. lugubris Motsch.
Stethoxus subsulcatus Lec. Pr. Ac. VII, 221.
lateralis *Fabr., Lec.** Pr. Ac. Nat. Sc. VII, 367.
ellipticus *Lec.* ibid. VII, 368.

STAPHYLINIDÆ.

Staphylinus Linn.

villosus *Grav.**

Philonthus Leach.

two species.

SILPHIDÆ.

Necrophorus Fabr.

mediatus *Fabr.**

Silpha Linn.

peltata *Lec.**
Scarabæus peltatus Catesby.
Silpha americana Linn.
lapponica *Herbst.**
S. caudata Say.
S. tuberculata Germ.
S. californica Mann.
Oiceoptoma granigerum Chevr.
truncata *Say.**
ramosa *Say.**

NITIDULIDÆ.

Carpophilus Leach.

pallipennis *Lec.**
C. floralis Er. Germ. Zeitschr. IV, 261.
Cercus pallipennis Say.

Nitidula Fabr.

zieziac *Say.**

CUCUJIDÆ.

Læmophlœus Er.

biguttatus *Mels.**
Cucujus biguttatus Say.
Læmophlœus bisignatus Guér.

Nausibius Redt.

dentatus *Redt.** Fauna Austr. 999.
Lyctus dentatus Fabr.
Silvanus dentatus Say.

DERMESTIDÆ.

Dermestes Linn.

marmoratus *Say.**
fasciatus *Lec.* Proc. Acad. Nat. Sc. VII, 107.

Attagenus Latr.

spurcus *Lec.* Proc. Acad. Nat. Sc. VII, 109.
?A. cylindricornis Say.
dichrous *Lec.* Proc. Acad. Nat. Sc. VII, 110.

Trogoderma Latr.

pusillum *Lec.* Proc. Acad. Nat. Sc. VII, 111.

PARNIDÆ.

Heliehus Er.

foveatus *Lec.* Proc. Acad. Nat. Sc. VI, 43.
æqualis *Lec.* Proc. Acad. Nat. Sc. VII, 81.

SCARABÆIDÆ.

Strategus Hope.

Julianus *Burm.*, Lamell. III, 133.

Aphonus Lec.

tridentatus *Lec.** Proc. Acad. Nat. Sc. VIII, 22.
Scarabæus tridentatus Say.

Ligyrus Burm.

gibbosus *Lec.** Proc. Acad. Nat. Sc. VIII, 20.
Scarabæus gibbosus DeGeer.
Podalgus variolosus Burm.

Phileurus Latr.

valgus *Dej.,** Burm., Lamell. III, 160.
Geotrupes valgus Fabr.
Phileurus castaneus Hald.

Cremastochilus Knoch.

saucius *Lec.** Journ. Ac. Nat. Sc. 2d ser. IV, 16.

Euryomia Burm. (emend. Lac.)

melancholica *Lac.** Gen. Col. III, 528.
Cetonia melancholica Gory.
Kernii *Lac.* ibid.
Euphoria cernii Hald.
Clarkii *Lac.* ibid.
Euphoria Clarkii Lec. Proc. Acad. Nat. Sc. VI, 414.

Allorhina Burm. (emend. Lac.)

mutabilis? *Lac.* Gen. Col. III, 497.
Cotinis mutabilis Burm., Lamell. I, 255.
Gymnetis mutabilis Gory.

Anomala Samouelle.

varians *Burm.**
Melolontha varians Fabr.

Strigoderma Burm.

arboricola *Burm.**
Melolontha arboricola Fabr.

Polyphylla Harris.

decemlineata *Lec.**
Melolontha 10-lineata Say.

Thyce Lec.

squamicollis *Lec.* J. Ac. Nat. Sc. 2d ser. III, 232.

Lachnosterna Hope.

lanceolata *Lec.**
Melolontha lanceolata Say.
Tostegoptera lanceolata Blanchard.

Dichelonycha Kirby.

sulcata *Lec.* Journ. Acad. Nat. Sc. 2d ser. III, 281.

Hoplia Illiger.

laticollis *Lec.* Journ. Ac. Nat. Sc. 2d ser. III, 284.

Trox Fabr.

alternans *Lec.** Proc. Acad. Nat. Sc. VII, 211.

Canthon Illiger.

praticola *Lec.*,* ante, 10.

BUPRESTIDÆ.

Psiloptera Sol. (emend. Lac.)

Woodhousei *Lec.**
Dicerca Woodhousei Lec.
var. *Psiloptera valens* Lec.

Ancylochira Esch.

confluens *Lec.**
Buprestis confluens Say.
alternans *Lec.* Trans. Am. Phil. Soc. XI, 207.
subornata *Lec.* Trans. Am. Phil. Soc. XI, 208.

Melanophila Esch.

miranda *Lec.*
Phænops mirandus Lec. Proc. Acad. VII, 83.

Anthaxia Esch.

retifera *Lec.* Trans. Am. Phil. Soc. XI, 215.
imperfecta *Lec.* Trans. Am. Phil. Soc. XI, 215.

Chrysobothris Esch.

quadrilineata *Lec.* Trans. Am. Phil. Soc. XI, 233.
cuprascens *Lec.* Trans. Am. Phil. Soc. XI, 233.

Acmæodera Esch.

variegata *Lec.* Proc. Acad. Nat. Sc. VI, 67.
mixta *Lec.** Trans. Am. Phil. Soc. XI, 227.

ELATERIDÆ.

Cratonychus Er.

exuberans *Lec.* Trans. Am. Phil. Soc. X, 477.

TELEPHORIDÆ.

Silis Charp.

difficilis *Lec.*

Telephorus Geoffr.

fidelis *Lec.*

MELYRIDÆ.

Collops Er.

bipunctatus *Er.**
Malachius bipunctatus Say.

Dasytes Fabr.

erythropus *Lec.* Proc. Acad. Nat. Sc. VI, 171.

CLERIDÆ.

Cymatodera Gray.

longicornis *Lec.*

Trichodes Herbst.

ornatus *Say.**

Clerus Geoffr.

mexicanus *Spin.*
mœstus *Klug.*
C. truncatus Lec.

Corynetes Fabr.

rufipes *Fabr.**
violaceus *Fabr.**

PTINIORES.

Niptus Boield.

ventriculus *Lec.*, ante, 13.

Trypopitys Redt.

punctatus *Lec.*, ante, 13.

TENEBRIONIDÆ.

Epitragus Latr.

canaliculatus *Say.**

Eurymetopon Esch.

abnorme *Lec.*
atrum? *Lec.*

Pactostoma Lec.

anastomosis *Lec.**
Asida anastomosis Say.

Pelecyphorus Sol.

sordidus *Lec.** Proc. Acad. Nat. Sc. VI, 46.

Euschides Lec.

convexicollis *Lec.* Proc. Acad. Nat. Sc. VII, 224.
obovata *Lec.*
convexa *Lec.*,* ante, 14.
polita *Lec.*
Asida polita Say.

Asida Latr.

opaca *Say.*
Euschides opaca Lec.

Zopherus Gray.

concolor *Lec.*

Eleodes Esch.

obscura *Lec.**
Blaps obscura Say.
?Blaps hispilabris Say.
acuta *Lec.**
Blaps acuta Say.
tricostata *Lec.**
Blaps tricostata Say.
Pimelia alternata Kirby.
gracilis *Lec.* Proc. Acad. Nat. Sc. 1858, 184.
sponsa *Lec.* ibid. 184.
caudifera *Lec.* ibid. 184.
obsoleta *Lec.**
Blaps obsoleta Say.
debilis *Lec.* Proc. Acad. Nat. Sc. 1858, 185.
extricata *Lec.**
Blaps extricata Say.
carbonaria *Lec.**
Blaps carbonaria Say.
nigrina *Lec.* Proc. Acad. Nat. Sc. 1858, 186.

Embaphion Say.

contusum *Lec.* J. Acad. Nat. Sc. 2d ser. IV, 40.*

Eusattus Lec.

reticulatus *Lec.**
Zophosis reticulata Say.

Blapstinus Dej.

pratensis *Lec.*,* ante, 15.

Nyctobates Esch.

pensylvanicus *Lec.**
Tenebrio pensylvanicus Knoch.
Upis chrysops Herbst.

Xystropus Sol.

pinguis *Lec.*, ante, 16.

Cistela Fabr.

sericea *Say.**

MELOIDÆ.

Meloe Linn.

sublævis *Lec.* Proc. Acad. Nat. Sc. VII, 84.
parvulus *Hald.* Proc. Acad. Nat. Sc. VI, 404.
M. parvus‖Hald.

Lytta Fabr.

biguttata *Lec.* Proc. Acad. Nat. Sc. VI, 332.
maculata *Say.**
costata *Lec.* Proc. Acad. Nat. Sc. VII, 84.
longicollis *Lec.** Proc. Acad. Nat. Sc. VI, 343.
Fabricii *Lec.** Proc. Acad. Nat. Sc. VI, 343.
L. cinerea‖Fabr., Harris.

Tetraonyx Latr.

fulva *Lec.* Proc. Acad. Nat. Sc. VI, 344.

Nemognatha Illiger.

nigripennis *Lec.* Proc. Acad. Nat. Sc. VI, 347.
cribraria *Lec.* Proc. Acad. Nat. Sc. VI, 348.
immaculata *Say.**

Zonitis Fabr.

flavida *Lec.* Proc. Acad. Nat. Sc. VI, 349
rufa *Lec.* Proc. Acad. Nat. Sc. VII, 85.

ŒDEMERIDÆ.

Calopus Fabr.

angustus *Lec.*

Asclera Schmidt.

obscura *Lec.* Proc. Acad. Nat. Sc. VII, 21.

Mycterus Oliv.

concolor *Lec.* Proc. Acad. Nat. Sc. VI, 235.

CURCULIONIDÆ.

Bruchus Linn.

one species.

Ophryastes Schönh.

tuberosus *Lec.* Proc. Acad. Nat. Sc. VI, 443.
vittatus *Schönh.**
Liparus vittatus Say.

Tanymecus Germ.

lautus *Lec.* Proc. Acad. Nat. Sc. VII, 85.

Sitones Germ.

seissifrons *Say.*

Cleonus Schönh.

lutulentus *Lec.*, ante, 18.

Anthonomus Germ.

one species.

Baridius Schönh.

one species.

Cossonus Clairv.

one species.

Tomicus Latr.

pini *Harris.**
Bostrichus pini Say.
caligraphus *Germ.**
Bostrichus exesus Say.

CERAMBYCIDÆ.

Derobrachus Serv.

geminatus *Lec.* Proc. Acad. Nat. Sc. VI, 233.

Prionus Geoffr.

curvatus *Lec.*, ante, 19.
palparis *Say.**
fissicornis *Hald.**

Criocephalus Muls.

asperatus *Lec.*, ante, 19.

Elaphidion Serv.

villosum *Hald.**
Stenocorus villosus Fabr.
Stenocorus putator Peck.
debile *Lec.* Proc. Acad. Nat. Sc. VI, 442.

Eriphus Serv.

? ignicollis *Say* (Callidium).*
Callidium sanguinicolle Germ.
? rutilans *Lec.* (Arhopalus).

Arhopalus Serv. (emend. Lec.)

pictus *Lec.**
Cerambyx pictus Drury.
Leptura Robiniæ Forster.
Clytus flexuosus Fabr.

Tylosis Lec.

maculatus *Lec.*

Stenaspis Dupont.

solitaria *Lec.**
Cerambyx solitarius Say.
Smileceras solitarium Lec.

Rhagium Fabr.

lineatum *Schönh.**
Stenocorus lineatus Oliv.

Leptura Linn.

auripilis *Lec.*

Monilema Say.

appressum *Lec.*

Monohammus Latr.

clamator *Lec.*

Stenostola Muls.

pergrata *Lec.**
Saperda pergrata Say.

Tetraopes Dalm.

canescens *Lec.*

Saperda Fabr.

concolor *Lec.*

Ædilis Serv.

spectabilis *Lec.*, ante, 22.

CHRYSOMELINÆ.

Lema Fabr.

trivirgata *Lec.*, ante, 22.

Urodera Lac.

crucifera *Lac.* Mon. Chrysom. II, 454.

Cryptocephalus Geoffr.

confluens *Say.**

Colaspis Fabr.

one species.

Myochrous Chevr.

denticollis *Lec.**
Eumolpus denticollis Say.

Chrysomela Linn.

auripennis *Say** (cum var. cœrulea).
interrupta *Fabr.**
formosa *Say.**

Œdionychis Latr.

lugens *Lec.*, ante, 24.

Haltica Fabr.

alternata *Illiger.**
H. quinquevittata Say.
semicarbonata *Lec.*, ante, 25.
ambiens *Lec.*, ante, 25.
obliterata *Lec.*, ante, 26.
punctipennis *Lec.*,* ante, 25.
torquata *Lec.*, ante, 26.
bitæniata *Lec.*, ante, 26.

Luperus Geoffr.

rufipes *Lec.*, ante, 27.

Galleruca Geoffr.

one species.

Microrhopala Chevr.

cyanea *Lec.**
Hispa cyanea Say.
? Hispa Hecate Newman.

Cassida Herbst.

sexpunctata *Fabr.**
C. bistripustulata Herbst.

EROTYLIDÆ.

Erotylus Fabr.

Boisduvalii *Chevr.*

COCCINELLIDÆ.

Anisosticta Chevr.

vittigera *Lec.**
Hippodamia vittigera Mann.

Hippodamia Chevr.

Lecontii *Muls.**
convergens *Guérin.**
H. modesta Mels.

Coccinella Linn.

monticola *Mels.**

Psyllobora Chevr.

vigintimaculata *Say.**

Brachiacantha Chevr.

albifrons *Lec.**
Coccinella albifrons Say.

Epilachna Chevr.

corrupta *Muls. Cocc.* 815.

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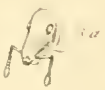
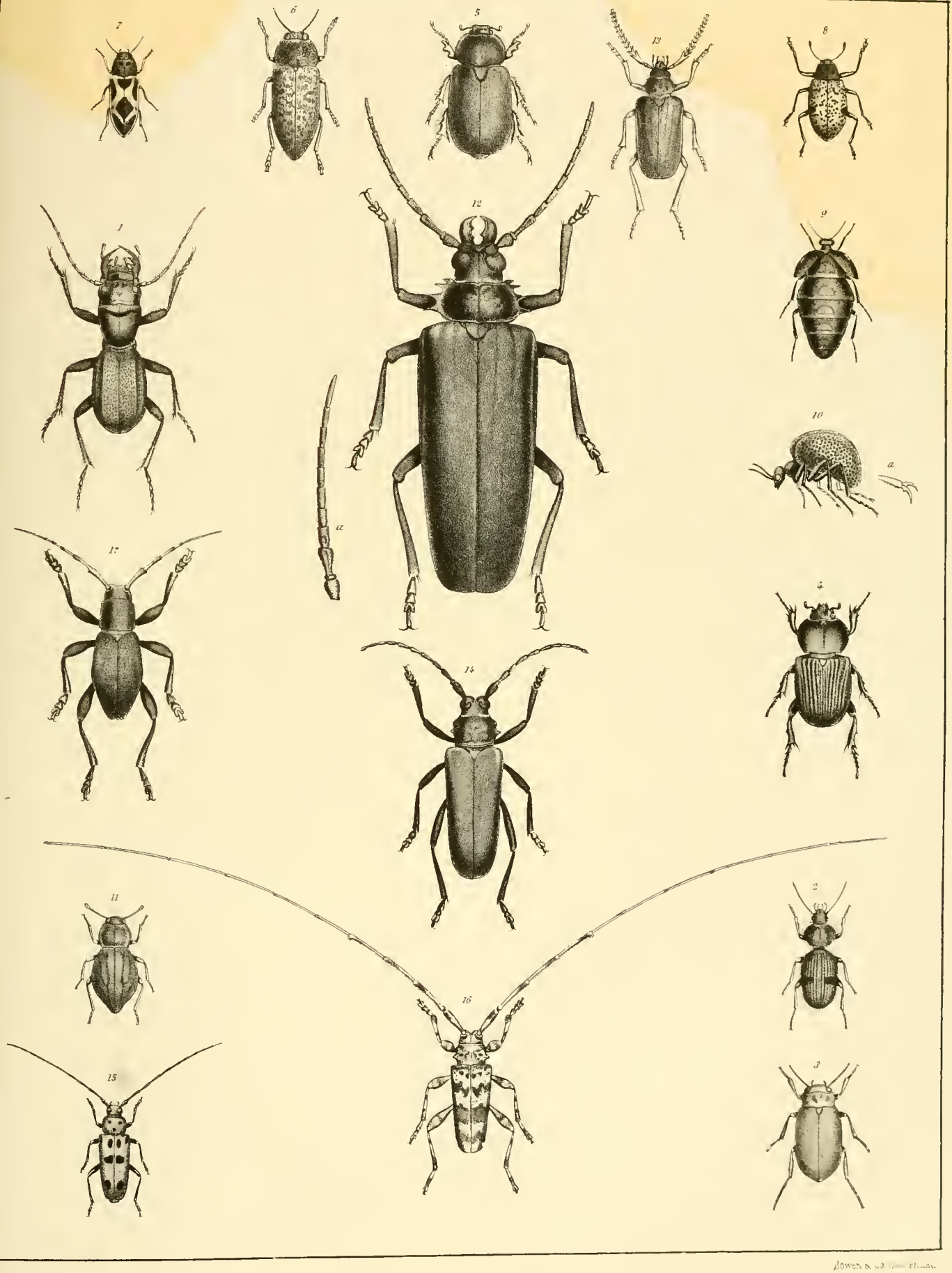


1 DICAELUS LAEVIPENNIS.
2 CALOSOMA LUXATUM
3 SILPHA TRUNCATA
4 OMORGUS SCUTELLARIS
5 LACHNOSTERNA LANCEOLATA
6 POLYPHYLLA 10-LINEATA
7 EUSATTUS RETICULATUS
8 EMBAPHION PRESSUM
9 ASIDA OPACA.
10 EUSCHIDES [illegible]NVEXA
11. PELECYPHORUS SORDI[illegible]
12. C[illegible]EONUS ANGULARIS
13 [illegible]PHRYAS[illegible]NATUS
14 PRIONUS FISSICORNIS
15 DRYOBIUS SEXFASCIATUS
16 ARROPALUS [illegible]HARUS

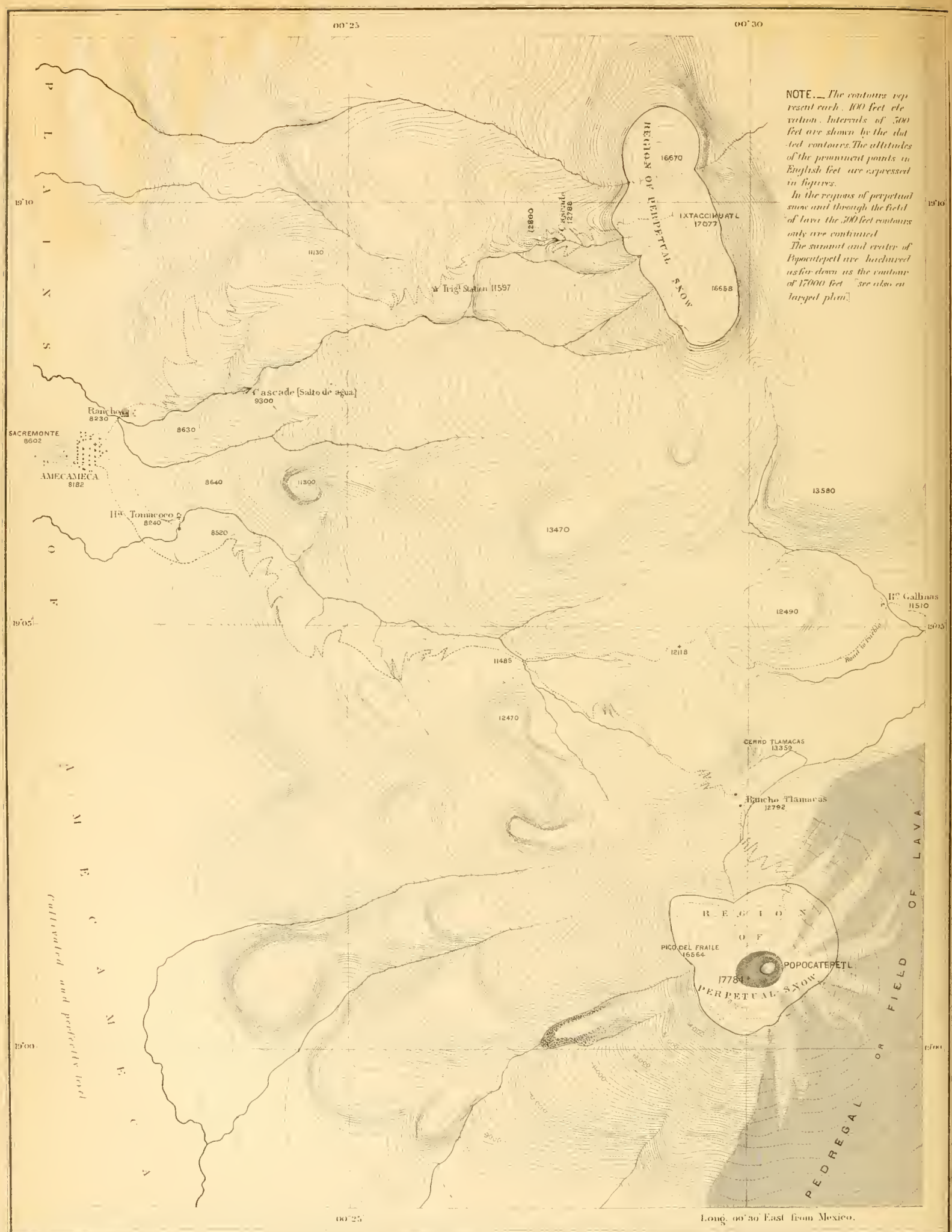


1. AMBLYCHILA CYLINDRIFORMIS.
2. MICRIXYS DISTINCTUS.
3. ANISOMERA CORDATA.
4. PHILEURUS VALGUS.
5. THYLE SQUAMI[illegible]IS
6. PSILOPTERA WOODHO[illegible]EI
7. MELANOPHILA MIRANDA.
8. EROTYLUS BOISDUVALII.
9. CYSTEODEMUS [illegible]LATUS
10. " WISLIZENI
11. PACHOSTOMA ANASTOMOSIS
12. DEROBRACHUS GEMINATUS
13. PRIONUS EMARG[illegible]NATUS.
14. STENASPIS SC[illegible]ARA
15. TYLOSIS MACULATUS
16. AEDILIS SPECTABILIS
17. MONILEMA APPRESSUM

MAP OF THE VOLCANO POPOCATEPETL AND ADJOINING VOLCANIC REGION.

Surveyed by August Sonntag, —— in 1857.

Drawn by A. Sonntag and Thomas Jekyll.



T. Sinclairs Eth. Phila.

Scale. $\frac{1}{100\,000}$.

10 5 0 10000 20000 30000 feet

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

OBSERVATIONS

ON

TERRESTRIAL MAGNETISM

IN

MEXICO.

CONDUCTED UNDER THE DIRECTION OF

BARON VON MÜLLER,

WITH NOTES AND ILLUSTRATIONS OF AN EXAMINATION OF THE VOLCANO POPOCATEPETL AND ITS VICINITY.

BY

AUGUST SONNTAG.

[ACCEPTED FOR PUBLICATION, MAY, 1859.]

COMMISSION

TO WHICH THIS MEMOIR HAS BEEN REFERRED.

Prof. STEPHEN ALEXANDER,
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Secretary S. I.

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PREFACE.

In 1856, Baron von Müller, of Germany, undertook an exploration in reference to the natural history of Mexico, and proposed to the Smithsonian Institution to make in its behalf a magnetic survey of the same country.

The offer having been accepted by the Institution, an appropriation was made to pay a portion of the salary of Mr. Sonntag, the assistant of Baron von Müller; and the magnetic instruments were intrusted to him which had previously been lent to Dr. Kane, and used by Mr. Sonntag himself, as one of the assistants of this lamented explorer in his last expedition.

Several records of observations, made at various places in Mexico, were at different times forwarded by Baron von Müller previous to his return to Germany, after which the Institution was informed by him that the instruments had been captured and destroyed by robbers.

No final report having been furnished by Baron von Müller, the crude observations made previous to the loss of the instruments have been reduced for publication at the expense of the Institution, by Mr. Sonntag, and the results given in the following pages.

Appended to the magnetical observations will be found a series of notes by Mr. Sonntag, upon the volcano of Popocatepetl and its vicinity.

The present memoir was critically examined by Mr. C. A. Schott, of the Coast Survey, and has been submitted to Professors Guyot and Alexander, of Princeton, as a commission of reference.

Joseph Henry,
Secretary S. I.

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PART I.

OBSERVATIONS

ON

TERRESTRIAL MAGNETISM IN MEXICO.

MAGNETICAL OBSERVATIONS.

INSTRUMENTS AND METHODS OF MAKING THE OBSERVATIONS.

The following observations were made with a set of magnetic instruments, furnished to Baron Von Müller by the Smithsonian Institution. The set contained a small theodolite, a declinometer, and a unifilar-magnetometer, made by Jones, and a Barrow dip-circle. The last-mentioned instrument I had formerly used in Dr. Kane's Arctic expedition, where it was subjected to some rough usage; and although it had been carefully adjusted before it was taken out to Mexico, the axis of the needles proved not to be as perfectly cylindrical as was desirable.

The determinations of absolute declination were made by means of the small theodolite and the declinometer. The azimuth circle of the first named instrument reads to thirty seconds by means of three verniers. It carries also a vertical circle, reading to single minutes. On its transit from Vera-Cruz to Potrero it suffered much, and the clamping-screws and the arms which carry the verniers were bent; this accounts for the great differences in the readings of the single verniers after the first observations. This instrument was used to determine the true [astronomical] and the magnetical azimuth of a mark, for the purpose of obtaining the magnetic declination. The first of these operations consisted in observing the mark and the first and second [western and eastern] limb of the sun, and in determining the error of the chronometer, by which the time of the solar observations was noted.

This error of local time was found generally by double altitudes of the sun, taken either with the theodolite or by means of a pocket-sextant, reading to single minutes, and a mercurial horizon. As the level attached to the vertical circle of the theodolite was not sufficiently sensitive, it was generally thought best to observe also with this instrument the reflected image of the sun. An equal number of observations of the upper and lower limb of the sun were always taken. A pocket-chronometer of Parkinson & Frodsham was used, and its rate on mean time continued always very small.

The declinometer carried a wooden box with a glass-tube of ten inches in length for suspending the magnet. This box was fastened to a table of the same material. After bringing the sides of the box nearly into the magnetic meridian and levelling it, the torsion was taken out of the silk thread by means of a brass collimater,

containing a very weak magnetic needle, and the torsion-circle turned until the collimater stood parallel to the box. Then the magnet was put in the place of the collimater and adjusted in height and illumination. It was of cylindrical form and hollow, the north-end being closed by a lens, and the south-end by a plane-glass into which a fine scale was cut.

The theodolite was mounted about one foot to the northward of the declinometer, and so adjusted that the scale on the magnet appeared distinctly. The vertical wire was put near the centre division, and after a set (generally three) of readings had been made, the magnet was turned 180° around its axis, so that the numbers of the scale, if they had appeared upright before, were now inverted. The first position of the scale is always marked *D.* (direct), the second *R.* (reversed). This operation was several times repeated, and the scale-division, corresponding to the axis of the magnet, determined by combining the means of the 1st and 3d set with the mean of the middle set. Next, the angle between the axis of the magnet and the mark was measured by means of the theodolite; and thus the magnetic azimuth of the mark was determined. By these observations the telescope of the theodolite was always several times reversed, so as to eliminate the error which might arise from a deviation of the optical axis, which changes with the focal length.

The declinometer was also used for observing the vibrations in the determination of horizontal intensity. For this purpose two wooden arms were attached to it, one carrying a telescope and ivory scale, the other a counterpoise-weight. After levelling the instrument and taking the torsion out of the supension-threads by means of the plummet, the magnet *D* 3 was suspended. It was of cylindrical form and 3.87 inches in length, and carries a small mirror (intended to reflect the ivory scale), the plane of which was perpendicular to the axis of the magnet. A thermometer was placed in the box and read after each set of observations. The magnet was steadied and the instrument turned in azimuth until the vertical wire of the telescope covered the centre division of the reflected scale. The magnet was found to hang so nearly horizontally, that it was not necessary to use a balance-ring. All vertical motion was carefully checked and the magnet deflected from 100 to 180 scale-divisions from the meridian by means of another small magnet, and then left to vibrate. The time of a passage of the central-division over the wire of the telescope was now observed, and recorded as the time of commencement or 0 vibration, and afterwards the time, when the centre-division passed the wire again at the completion of the 10th, 20th, 30th, 40th, and 50th vibrations, was accurately noted. The 100th, 200th, and 300th vibrations were also noted, and generally the extreme scale readings were recorded at the same time. After the 300th again every 10th to the 350th vibration was observed, thus obtaining six values for the time, in which the magnet made 300 vibrations, viz., from 0 to 300, from 10 to 310, etc.

Occasionally the coefficient of torsion was determined by reading at first the torsion-circle and the scale, then turning the torsion-circle 90° and reading the scale again, then turning it 180° in the opposite direction, and finally turning it back 90° to its original position, and reading the scale each time. It remained always nearly the same and was very small.

The unifilar-magnetometer was only used for experiments of deflection. The horizontal circle of this instrument read to 20 seconds. It supported a heavy copper box, which quieted the magnet, suspended in it, to a considerable extent. To this box were fastened two arms, of about 1.5 feet in length, with grooves, in which the deflecting magnet rested. One of these arms carries also the telescope and the scale, which was reflected from a small mirror, attached to the magnet in such a manner that its axis was parallel to the plane of the mirror. The deflecting magnet was the same used in the vibration experiments. After the instrument was levelled, and the torsion taken out of the silk thread, a magnet of somewhat smaller dimensions than the deflecting magnet was suspended. This last one was placed in the groove on the eastern arm at the distance of one foot, and the instrument turned until the middle of the scale appeared behind the vertical wire of the telescope. Then the circle was read and the magnet placed on the western arm at the same distance and the same pole pointing in the same direction (so that the opposite pole was now turned towards the deflected magnet), when the circle was read off again, and the south pole of the deflecting magnet placed where its north pole was before, without altering the distance. The instrument was now turned until the middle of the scale was again behind the vertical wire and the circle-reading noted. Then the magnet was placed on the eastern arm, at the same distance, and without changing the poles, etc. Afterwards the distance was increased to 1.3 feet, and the operation repeated. At the end of each set the temperature of the deflecting magnet was noted. In the observations with the dip-circle the instrument was brought into the meridian by turning the horizontal circle in azimuth until the dipping-needle indicated 90°. Then the circle was read and turned about 180°, when the needle was brought again into a vertical position and the horizontal circle was read once more. By means of these readings the needle was put in the magnetic meridian. The poles of the needles were reversed at each observation.

OBSERVATIONS AT VERA-CRUZ.

Description of Station No. I.—The instruments were mounted in the centre of a room, situated on the first floor, and in the northern corner of a villa or cottage, called "la Guacca," two hundred yards outside of the walls of Vera-Cruz, and on the south side of this city. The floor was of marble, and no basement below it. There was no iron in the neighborhood, the locks and hinges of the doors, etc., being of brass. On the walls of the city, two hundred yards to the north, were several heavy iron guns. The grounds near the villa consisted of sand and clay. The instruments were elevated about fourteen feet above the level of the sea, which is only five hundred yards distant.

STATION No. I. VERA CRUZ, VILLA "LA GUACCA."
Latitude 19° 12′. Longitude 96° 9′ W. of Greenwich.

Absolute magnetic declination. True azimuth of the mark A.[1]
1856. August 8, A. M. Small theodolite.

CIRCLE TO THE LEFT.			CIRCLE TO THE RIGHT.		
Object.	Chronometer.	Circle reading.	Object.	Chronometer.	Circle reading.
⊙ Ist limb	0h 59m 6s	118° 20′ 30″	Mark A	1h 16m —s	356° 34′ 30″
		18 0			36 0
		19 30			34 45
IId limb	1 3 9	118 2 30	⊙ Ist limb	1 18 42	88 41 0[2]
		1 30			39 30
		0 30			41 0
Mark A	1 8 —	356 34 0	⊙ IId limb	1 21 39	88 20 30
		35 15			19 30
		34 30			20 0
Mark A	1 27 —	326 16 45	Mark A	1 24 —	325 16 30
		18 0			16 30
		16 0			15 0
⊙ Ist limb	1 29 20	89 27 0	———	———	———
		26 0			
		27 0			
⊙ IId limb	1 31 32	89 2 0	———	———	———
		1 0			
		2 30			

Absolute magnetic declination. Altitudes of the sun, for the determiuation of time.
1856. August 8, A. M. Small theodolite.

DIRECT.			REFLECTED.		
Sun's limb.	Chronometer.	Circle reading.	Sun's limb.	Chronometer.	Circle reading.
	2h 9m 22s	29° 0′[3]		2h 4m 58s	332° 15′
Upper	10 21.5	15	Lower	5 57	0
	11 27	33		7 4	331 45
	2 13 40	29 30		2 18 46.5	328 30
Lower	14 40	45	Upper	19 50	15
	15 47	30 0		20 52	0
	2 27 24	33 15		2 22 4	328 15
Upper	28 27.5	30	Lower	23 7	0
				24 12	327 45
Lower	3 1 38	40 45	Lower	2 57 16	320 0
	2 43	41 0		58 20	319 45
Upper	3 4 44	42 0	Upper	3 8 54	316 45
	5 44	42 15		10 4	30

Index error assumed + 0° 8′.6.
Temperature of the air 7h 0m A. M., 80°.5 F.
" " 9 0 A. M., 83.0 F.
Barometer 9h 0m A. M., 29.98 inches.
Attached thermometer 84°.0 F.
Chronometer slow of Greenwich mean time + 2m 57s.7.
Daily rate 6s.3 slow.

[1] The mark A is the cross on the dome of the "Parroquia" [Parish Church], situated on the south side of the "Plaza de Armas," Vera Cruz. It is 2,310 feet distant from the Station No. I.

[2] After 1h 10m (Chron.) the sun had risen too high to be visible from the station, the theodolite was, therefore, put at another place, 12 feet distant, and bearing east by north (magn.) from the station.

[3] In these observations only one vernier of the vertical circle was read.

Zero point of the scale of the collimating magnet.

1856. August 7. Declinometer.

Chronometer.	Scale D.	Chronometer.	Scale R.	Chronometer.	Scale D.
$5^h\ 41^m$	68 6	$5^h\ 52^m$	75.0	$5^h\ 58^m$	68.8
	68 6		74 9		68.7
	68 8		75.0		68.6
	68.7		75.0		68.7

Zero point 71.8 on the scale. 1 division of the scale = 2′.1.

Absolute magnetic declination. Magnetical azimuth of the mark A.

1856. August 7. Theodolite and declinometer.

CIRCLE EAST.			CIRCLE WEST.		
Object.	Scale reading.	Circle reading.	Object.	Scale reading.	Circle reading.
Scale D	71.8	294° 38′ 15″	Scale R	72.1	294° 42′ 30″
$6^h\ 4^m$	72.0	38 15	$6^h\ 27^m$	72.1	43 0
	72.0	37 30		71.9	42 0
	71.9	294 38 0		72.0	294 42 30
Mark A	———	62 17 30	Mark A	———	62 24 0
		17 10			23 50
		16 30			23 0
		62 17 3			62 23 37
Mark A	———	62 23 30			
		23 30			
		23 0			
		62 23 20			
Scale D	72.1	294 43 45			
$6^h\ 40^m$	72.1	44 30			
	72.1	43 40			
	72.1	294 43 58			

Mark A bears N. 52° 20′ 57″ W. Mark A bears N. 52° 18′ 53″ W.

" " 20 38

Magnetical azimuth of mark A, N. 52° 19′ 50″ W.

Horizontal intensity. Experiments of vibration.

1855. August 7, A. M. Magnet D 3 suspended.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$2^h\ 12^m\ 30^s.5$	300	$2^h\ 25^m\ 38^s.0$	$13^m\ 7^s.5$
10	12 56.3	310	26 4.5	8 2
20	13 23.5	320	26 30.7	7.2
30	13 49.0	330	26 57.0	8 0
40	14 16.0	340	27 23.5	7 5
50	14 41.5	350	27 49.5	8 0
100	16 52 5	200	21 15.5	
				13 7.73

Extreme scale readings.

0	8	52
50	10	50
100	12	48
200	16	44
350	19	41

Temperature 81° 5 F.

Time of 1 vibration $2^s.6258$.

The chronometer, by which the time was noted, was $6^h\ 22^m$ fast of mean local time.

Horizontal intensity. Experiments of vibration.

1856. August 7, A. M. Magnet D 3 suspended.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$2^h\ 32^m\ 17^s.5$	300	$2^h\ 45^m\ 25^s.0$	$13^m\ 7^s.5$
10	32 43 3	310	45 50 7	7 4
20	33 9.7	320	46 17.5	7 8
30	33 36 0	330	46 43 5	7.5
40	34 2.5	340	47 10.0	7 5
50	34 28.3	350	47 36 0	7.7
100	36 39.7	200	41 2 0	
				13 7.57

Extreme scale readings.

0	11 0	49 0
50	12 5	47 0
200	17.8	42.2
300	19 7	40 5
350	21.0	39.0

Temperature 81°.5 F.

Time of 1 vibration $2^s.6252$.

1856. August 7, A. M. Magnet D 3 suspended.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$2^h\ 49^m\ 34^s.0$	300	$3^h\ 2^m\ 41^s.5$	$13^m\ 7^s.5$
10	50 0.0	310	3 7.5	7.5
20	50 26 3	320	3 34 0	7 7
30	50 52.5	330	4 0 5	8 0
40	51 19 0	340	4 26 5	7.5
50	51 45 0	350	4 52.5	7.5
100	53 56 9	200	2 58 19 0	
				13 7.62

Extreme scale readings.

0	9 0	51.0
100	13 0	47.0
200	16 0	44 0
300	18.0	42.0
350	18 8	41.2

Temperature 82° F.

Time of 1 vibration $2^s.6254$.

1857. August 8, A. M. Magnet D suspended.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$5^h\ 21^m\ 34^s.0$	300	$5^h\ 34^m\ 42^s\ 0$	$13^m\ 8^s.0$
10	22 0.0	310	35 9.0	9.0
20	22 26.5	320	35 34.0	7.5
30	22 53.0	330	36 0 5	7 5
40	23 19.0	340	36 27 0	8.0
50	23 45 0	350	36 53.5	8 5
100	25 56.5	200	30 20.0	
				13 8 08

Extreme scale readings.

0	8.0	52.0
50	10 0	50 0
100	12.0	48.0
200	16.0	44.0
350	19.0	41.0

Temperature 84°.2 F.

Time of 1 vibration $2^s.6269$.

Horizontal intensity. Experiments of vibration.

1856. August 8, A. M. Magnet D 3 suspended.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	5h 42m 2s.0	300	5h 55m 9s 0	13m 7s 0
10	42 28.0	310	55 36.0	8 0
20	42 54.0	320	58 2 0	8.0
30	43 21.0	330	56 28.5	7.5
40	43 47 0	340	56 54.5	7.5
50	44 13 0	350	57 21.0	8 0
100		200		13 7.67

Extreme scale readings.

0	10.0	50 0	Temperature 84°.3 F.
50	12.0	48 0	
100	13.0	47.0	Time of 1 vibration 2s6256.
200	17.0	43.0	
350	20.0	40.0	

1856. August 8, A. M. Magnet D 3 suspended.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	5h 59m 23s.0	300	6h 12m 30s.2	13m 7s.2
10	59 49.0	310	12 56 2	7.2
20	6 0 15.0	320	13 23 5	8.5
30	0 41.2	330	13 49.0	7.8
40	1 7.3	340	14 16 0	8.7
50	1 34.2	350	14 42 0	7.8
100	3 45.0	200	8 7.5	13 7.87

Extreme scale readings.

0	14.0	46.0	Temperature 84°.4 F.
50	16.0	44.0	
100	17.3	42.0	Time of 1 vibration 2s.6262.
200	18.3	40.0	
350	22.0	37.5	

Experiments of deflections. Distance 1 foot.

1856. August 7, 1h 48m to 2h 20m P. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
E.	E.	143° 40′ 50″	40′ 40″		85°.0 F.
		40 30			
"	E.	143 40 40	40 30		
		40 20			
"	E.	143 41 0	41 20		
		41 40		14° 52′ 52″	
"	W.	128 48 20	48 5		
		47 50			
"	W.	128 48 20	48 5		
		47 50			
"	W.	128 48 0	47 45		
		47 30			

Horizontal intensity. Experiments of deflections. Distance 1 foot.

1856. August 7, $1^h\ 48^m$ to $2^h\ 20^m$ P. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
W.	E.	128° 39′ 45″	39′ 37″		
		39 30			
"	E.	128 39 50	39 40		
		39 30			
"	E.	128 39 50	39 40		
		39 30		15° 19′ 38″	
"	W.	143 58 40	58 25		
		58 10			
"	W.	143 59 50	59 50		
		59 50			
"	W.	143 59 40	59 35		85 0
		59 30			
			Mean	15 6 15	

Experiments of deflections. Distance 1.3 feet.

1856. August 7, $2^h\ 23^m$ to $2^h\ 38^m$ P. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
E.	E.	139° 40′ 30″	40′ 15″		85°.2
		40 0			
"	E.	139 40 30	40 20		
		40 10		6° 48′ 45″	
"	W.	132 52 0	51 40		
		51 20			
"	W.	132 51 50	51 25		
		51 0			
W.	E.	132 49 20	49 10		
		49 0			
"	E.	132 49 30	49 15		
		49 0		6 55 25	
"	W.	139 44 35	44 22		
		44 10			
"	W.	139 45 10	44 55		85.2
		44 40			
			Mean	6 52 6	

Experiments of deflections. Distance 1 3 feet.

1856. August 7, $5^h\ 33^m$ to $5^h\ 52^m$ P. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
E.	E.	139° 38′ 40″	38′ 22″		84°.5
		38 5			
"	E.	139 38 40	38 25		
		38 10			
				6° 50′ 47″	

Horizontal intensity. Experiments of deflections. Distance 1.3 feet.

1856. August 7, $5^h\ 33^m$ to $5^h\ 52^m$ P. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
E.	W.	132° 47′ 55″	47′ 32″		
		47 10			
"	W.	132 48 0	47 40		
		47 20			
W.	E.	132 48 40	48 30		
		48 20			
"	E.	132 48 30	48 22		
		48 15			
"	W.	139 40 0	39 50	6° 51′ 31″	
		39 40			
"	W.	139 40 20	40 5		84.5
		39 50			
			Mean	6 51 9	

Experiments of deflections. Distance 1 foot.

1856. August 7, $5^h\ 57^m$ to $6^h\ 17^m$ P. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
W.	E.	128° 42′ 50″	42′ 35″		84°.2
		42 20			
"	E.	128 43 10	42 50		
		42 30			
"	W.	143 52 40	52 20	15° 9′ 36″	
		52 0			
"	W.	143 52 30	52 17		
		52 5			
E.	E.	143 44 10	43 55		
		43 40			
"	E.	143 44 5	43 52		
		43 40			
"	W.	128 40 5	39 47	15 4 7	
		39 30			
"	W.	128 40 0	39 45		84.2
		39 30			
			Mean	15 6 52	

Magnetic inclination.

1856. August 8, 0^h 15^m P. M. Needle No. 2. A. North pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
46° 49′	45° 7′	47° 13′	45° 16′	134° 45′	133° 20′	134° 49′	136° 16′
55	16	19	22	32	6	34	135 58
46 52	45 11.5	47 16	45 19	134 38.5	133 13.0	134 41.5	136 7
46 1.7		46 17.5		133 55.7		135 24.3	
46 9.6				134 40.0			
45 44.8							

1856. August 8, 0^h 15^m P. M. Needle No. 2. A. South pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
138° 8′	140° 7′	136° 58′	138° 40′	43° 50′	42° 5′	43° 18′	41° 50′
137 51	139 50	41	23	44 1	15	30	59
137 59.5	139 58.5	136 49.5	138 31.5	43 55.5	42 10.0	43 24.0	41 54.5
138 59.0		137 40.5		43 2.7		42 39.3	
138 19.7				42 51.0			
42 15.6							

1856. August 8, 0^h 40^m P. M. Needle No. 1. A. South pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
45° 34′	44° 0′	42° 55′	41° 9′	135° 18′	137° 2′	137° 13′	139° 5′
44	9	43 4	19	2	136 46	136 56	138 47
45 39.0	44 4.5	42 59.5	41 14.0	135 10.0	136 54.0	137 4.5	138 56.0
44 51.7		42 6.7		136 2.0		138 0.2	
43 29.2				137 1.1			
43 14.0							

1856. August 8, 0^h 40^m P. M. Needle No. 1. A. North pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
133° 30′	135° 8′	137° 23′	139° 21′	48° 38′	47° 0	45° 13′	43° 46′
16	134 51	8	5	47	8	20	51
133 23.0	134 59.5	137 15.5	139 13.0	48 42.5	47 4.0	45 16.5	43 48.5
134 11.2		138 14.2		47 53.2		44 32.5	
136 12.7				46 12.9			
45 0.1							

Magnetic inclination.

1856. August 8, 1^h 5^m P. M. Needle No. 2. A. South pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
44° 20′ 31	42° 14′ 22	44° 0′ 9	42° 27′ 37	138° 35′ 18	136° 48′ 32	138° 19′ 4	140° 7′ 139 50
44 25.5	42 18.0	44 4.5	42 32.0	138 26.5	136 40.0	138 11.5	139 58.5
43 21.7		43 18.3		137 33.2		139 5.0	
43 20.0				138 19.1			
42 30.5							

1856. August 8, 1^h 5^m P. M. Needle No. 2. A. North pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
134° 53′ 38	136° 23′ 7	134° 30′ 14	136° 30′ 13	46° 32′ 44	44° 51′ 45 5	45° 53′ 46 6	44° 14′ 27
134 45.5	136 15.0	134 22.0	136 21.5	46 38.0	45 58.0	45 59.5	44 20.5
135 30.2		135 21.8		45 48.0		45 10.0	
135 26.0				45 29 0			
45 1.5							

OBSERVATIONS AT POTRERO.

Description of Station No. II.—Potrero is the first large sugar estate on the road from Vera Cruz to Orizaba, about twenty miles to the east of the last-mentioned town. Its elevation above the level of the Mexican Gulf was found 1,988 English feet (by barometrical observations). The magnetical observations have been made in a shed or barn, consisting of a roof of palm leaves supported by a number of poles. There is no iron within several hundred yards of it. The shed is situated about eighty yards to the N. N. W. of the store. A tree, nearly four miles to the west of the station, was used for a mark (A) in the determination of the absolute declination.

STATION NO. II. POTRERO.

Latitude 18° 56′. Longitude 96° 48′ W. of Greenwich.

Absolute magnetic declination. True azimuth of the mark A.

1856. August 18, A. M. Small theodolite.

CIRCLE TO THE LEFT.			CIRCLE TO THE RIGHT.		
Object.	Chronometer.	Circle reading.	Object.	Chronometer.	Circle reading.
⊙ Ist limb	$1^h\ 3^m\ 48^s$	249° 25′	⊙ IId limb	$1^h\ 27^m\ 7^s$	250° 40′
		26			33.5
		30			35
⊙ Ist limb	6 48	249 44	⊙ Ist limb	28 46	251 19
		38			13
		38			14
⊙ IId limb	8 31	249 19	Mark A	———	94 14
		13			20
		13.5			27
⊙ IId limb	10 17	249 25	Mark A	———	94 18
		21.5			20
		20			26
Mark A	———	94 14	⊙ Ist limb	1 37 10	251 55
		18			47
		23			47
Mark A	———	94 17	⊙ IId limb	39 14	251 26
		18			22
		23			20
⊙ Ist limb	1 18 22	250 31			
		26			
		23			
⊙ Ist limb	20 16	250 40			
		34			
		33.5			
⊙ IId limb	21 50	250 12			
		9			
		7			
⊙ IId limb	23 20	250 19.5			
		14			
		14			

Altitudes of the sun, for the determination of time.

1856. August 17, P. M. Small theodolite.

REFLECTED.			DIRECT.		
Sun's limb.	Chronometer.	Circle reading.	Sun's limb.	Chronometer.	Circle reading.
Upper	10h 1m 49s	38° 25′	Upper	10h 14m 53s	324° 21′
		26			20.5
Upper	3 9	38 5.5	Upper	16 11	324 38
		6			38
Upper	6 59	37 13.5	Upper	17 15	324 55
		13			54

Absolute magnetic declination. Altitudes of the sun, for the determination of time.

1856. August 17, P. M. Small theodolite.

REFLECTED.			DIRECT.		
Sun's limb.	Chronometer.	Circle reading.	Sun's limb.	Chronometer.	Circle reading.
Lower	10h 8m 9s	36° 23′.5	Lower	10h 18m 0s	325° 36′
		24			36
Lower	10 7	35 56	Lower	18 45	325 47
		56			47
Lower	11 46	35 31	Lower	19 30	325 58
		30			58

Temperature of air 77° F. Barometer 28.17 English inches. Attached thermometer 76° F.
During the observations the sun was often obscured by clouds.

1856. August 18, A. M. Small theodolite.

DIRECT.			REFLECTED.		
Sun's limb.	Chronometer.	Circle reading.	Sun's limb.	Chronometer.	Circle reading.
	1h 51m 36s	23° 30′[1]		1h 57m 2s	334° 20′
Lower	52 17	40	Upper	57 45	10
	53 0	50		58 27	0
	1 54 15	24 40		2 0 3	334 10
Upper	54 57	50	Lower	0 42	0
	55 43	25 0		1 27	333 50
	2 8 3	27 20		2 2 51	333 30
Lower	8 52	30	Lower	3 28	20
	9 30	40		4 7	10
	2 10 47	28 30		2 5 24	332 20
Upper	11 23	40	Upper	6 6	10
	12 4	50		6 47	0

Temperature of air 75°.0. Barometer 28.10 English inches. Attached thermometer 74°.0.

[1] In these observations only one vernier of the vertical circle was read.

Absolute magnetic declination. Magnetical azimuth of the mark A.

1856. August 17, A. M. Theodolite and declinometer.

CIRCLE TO THE RIGHT.

Chronometer.	Scale.	Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$0^h\ 52^m$	71 8	$0^h\ 57^m$	71.7	180° 29′	180° 28′.3	
	71.8		71.7	31		
D	72 0	R	71.7	25		
Mark A	—	—	—	277 31	277 24.3	N. 83° 4′.0 W.
				20		
				22		
1 3	71 5	1 27	71.8	180 27	180 27.5	
	71 4		71.8	31.5		
R	71.4	R	71.8	24		
Mark A	—	—	—	277 29	277 21.7	83 5.8
				16		
				20		
2 0	71.8	2 3	71.6	180 22	180 22.3	
	71.7		71.6	27		
D	71.7	D	71.6	18		
Mark A	—	—	—	277 27.5	277 21.2	83 1.1
				16		
				20		
					Mean	83 3.6

1856. August 17. A. M. Theodolite and declinometer.

CIRCLE TO THE LEFT.

Chronometer.	Scale.	Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$1^h\ 33^m$	71.8	———	———	180° 29′	180° 28′.7	
	71 7			32		
R	71.7			25		
Mark A	—	—	—	277 32.5	277 26.2	N. 83° 2′.5 W.
				22		
				24		
1 42	71.8	———	———	180 19.5	180 18.8	
	71.8			23.5		
R	71.8			13.5		
Mark A	—	—	—	277 27	277 20.3	82 58.5
				15		
				19		
1 49	72.0	$1^h\ 55^m$	72.4	180 23	180 23.0	
	72.0		72.5	27		
R	72.0	D.	72.4	19		
Mark A	—	—	—	277 28	277 21.0	83 2.0
				15		
				20		
					Mean	83 1.0

Magnetical azimuth of mark A, N. 83° 2′.8 W.

Horizontal intensity. Experiments of vibration.

1856. August 16, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	6h 55m 17s.0	300	7h 8m 23s.0	13m 6s.0
10	55 43 0	310	8 49.5	6 5
20	56 9 5	320	9 15 0	5 5
30	56 35.5	330	9 41.5	6 0
40	57 1.5	340	10 8 0	6.5
50	57 28.0	350	10 34.0	6.0
100	59 38.5	200	4 0.5	
				13 6.08

Extreme scale readings.

0	13.0	47.0
100	16 4	43.6
200	19.4	41.0
350	22.0	38.0

Temperature 77°.0 F.

Time of 1 vibration 2s.6203.

Horizontal intensity. Experiments of vibration.

1856. August 16, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 304 vibrations.
0	7h 16m 23s.0	304	7h 29m 39s.5	13m 16s.5
10	16 49.0	314	30 6.0	17.0
20	17 15.0	324	30 32.0	17.0
30	17 41.0	334	30 58.0	17.0
40	18 7.5	344	31 24.5	17.0
50	18 33.5	354	31 51.0	17.5
100	20 44.5	200	25 7.0	
				13 17.0

Extreme scale readings.

50	13.0	47.0
100	14.5	45.5
200	17.0	42.5
354	20.5	39.0

Temperature 78°.0 F.

Time of 1 vibration 2s.6217.

1856. August 17, A. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	2h 53m 10s.0	300	3h 6m 16s.0	13m 6s.0
10	53 36.0	310	6 42.0	6.0
20	54 2.0	320	7 8.5	6.5
30	54 28.5	330	7 34.5	6.0
40	54 55.0	340	8 0 3	5.3
50	55 21.0	350	8 26.7	5.7
100	57 32.0	200	1 54.0	
				13 5 92

Extreme scale readings.

0	20.0	40.0
50	21 5	38.5
100	22.0	38.0
200	23.0	36.7
300	24 5	35 5
350	25.0	35.0

Temperature 78°.0 F.

Time of 1 vibration 2s.6197.

Horizontal intensity. Experiments of vibration.

1856. August 17, A. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	3h 10m 34s.0	300	3h 23m 39s.7	13m 5s.7
10	11 0.2	310	24 6.0	5.8
20	11 26.3	320	24 32.0	5.7
30	11 52.1	330	24 58.0	5.9
40	12 19.0	340	25 25.0	6.0
50	12 45.0	350	25 50.4	5.4
100	14 55.8	200	19 17.8	
				13 5.75

Extreme scale readings.

0	18.0	42.0
50	20.0	40.0
100	20.5	39 5
200	22.0	38.0
300	23.5	26.5
350	25.2	34.8

Coefficient of torsion.

Torsion circle.	Scale.
190°	298.5
100	293.2
280	304.1
190	297.8

Temperature 78°.0 F. Time of 1 vibration 2s.6192.

Experiments of deflections. Distance 1 foot.

1856. August 17, 0h 50m P. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
W.	E.	219° 36′ 20″	36′ 10″		81°.0
		36 0			
"	E.	219 36 20	36 .5		
		35 50		14° 56′ 16″	
"	W.	234 32 10	32 2		
		31 55			
"	W.	234 33 0	32 45		
		32 30			
E.	E.	234 40 20	40 10		
		40 0			
"	E.	234 40 35	40 22		
		40 10		15 4 15	
"	W.	219 36 25	36 10		
		35 55			
"	W.	219 36 10	35 52		
		35 35			81.0
			Mean	15 0 16	

Horizontal intensity. Experiments of deflections. Distance 1.3 foot.

1856. August 17, 1h 15m P. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
W.	W.	230° 33′ 0″	32′ 45″		80°.7
		32 30			
"	W.	230 32 55	32 42		
		32 30		6° 47′ 7″	
"	E.	223 45 50	45 37		
		45 25			
"	E.	223 45 50	45 35		
		45 20			
E.	W.	223 45 30	45 15		
		45 0			
"	W.	223 45 40	45 20		
		45 0		6 50 49	
"	E.	230 36 20	36 5		
		35 50			
"	E.	230 36 20	36 7		80.7
		35 55			
			Mean	6 48 58	

Magnetic inclination.

1856. August 17, 11h 25m A. M. Needle No. 2. A. North pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
45° 27′ 40	43° 41′ 54	44° 57′ 45 11	43° 18′ 34	135° 53′ 41	136° 43′ 32	135° 16′ 1	136° 39′ 26
45 33.5	43 47.5	45 4.0	43 26.0	135 47.0	136 37.5	135 8.5	136 32.5
44 40.5		44 15.0		136 12.2		135 50.5	
44 27.7				136 1.3			
41 13.2							

1856. August 17, 11h 25m A. M. Needle No. 2. A. South pole.

CIRCLE WEST.				CIRCLE EAST.			
Face east.		Face west.		Face west.		Face east.	
138° 32′ 17	140° 2′ 139 50	139° 5′ 138 54	140° 23′ 12	42° 21′ 36	40° 36′ 50	43° 2′ 15	41° 13′ 28
138 24.5	139 56.0	138 59.5	140 17.5	42 28.5	40 43.0	43 8.5	41 20.5
139 10.3		139 38.5		41 35.7		42 14.5	
139 24.4				41 55.1			
41 15.3							

1856. August 17, 0h 5m P. M. Needle No. 1. A. North pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
41° 37′ 51	39° 47′ 40 3	46° 51′ 47 5	44° 58′ 45 12	139° 32′ 14	140° 51′ 33	133° 0′ 132 42	135° 20′ 3
41 44	39 55	46 58	45 5	139 23	140 42	132 51	135 11.5
40 49.5		46 1.5		140 2.5		134 1.3	
43 25.5				137 1.9			
43 11.8							

1856. August 27, 0h 5m P. M. Needle No. 1. A. South pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
136° 5′ 135 46	137° 31′ 13	139° 23′ 5	140° 45′ 27	46° 46′ 47 0	45° 2 15	42° 28′ 43	40° 17′ 34
135 55.5	137 22.0	139 14.0	140 36.0	46 53.0	45 8.5	42 35.5	40 25.5
136 38.7		139 55.0		46 0.7		41 30.5	
138 16.8				43 45.6			
42 44.4							

OBSERVATIONS AT ORIZABA.

Description of Station No. III.—The instruments were mounted under a roof of palm leaves, in the garden of Mr. Thomas Grandison, at Cocolapam, about a thousand yards to the south of the town of Orizaba. A few hundred yards west of the magnetic station rises a huge mountain ridge, of ancient volcanic rock, to a height of 1,500 to 2,000 feet above the plain. This may possibly cause some small local disturbance.

The elevation of the station above the level of the sea was found by barometrical observations 4,042 English feet.

In the determination of absolute declination a break in a distant mountain ridge to the eastward was used as a mark (A).

No experiments of deflection have been made at Orizaba.

Station No. III. Cocolapam near Orizaba.

Latitude 18° 53′. Longitude 97° 4′ W. of Greenwich.

Absolute magnetic declination. Zero point of the scale of the collimating magnet.

1856. August 27, A. M. Declinometer.

Chronometer.	Scale R.	Chronometer.	Scale D.	Chronometer.	Scale R.	Chronometer.	Scale D.
$3^h\ 54^m$	71 8	$4^h\ 0^m$	70 9	$4^h\ 6^m$	72.5	$4^h\ 13^m$	71.6
	71.8		70.9		72.5		71.5
	71.8		70.9		72.5		71.5
	71.8		70.9		72.5		71.5

Zero point on the scale 71.7.

Absolute magnetic declination. Magnetical azimuth of the mark A.

1856. August 27, A. M. Theodolite and declinometer.

CIRCLE TO THE LEFT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$4^h\ 17^m$	71.7	98° 44′	98° 47′.8	
	71.7	47		
D	71 6	52.5		
Mark A	—	358 23	358 21.0	N. 79° 33′.2 E.
		13		
		27		
4 42	71 6	98 42	98 46 3	
	71 7	45		
R	71.7	52		
Mark A	—	358 23.5	358 21.0	79 34.7
		12		
		27.5		
			Mean	N. 79 34 0 E.

1856. August 27. A. M. Theodolite and declinometer.

CIRCLE TO THE RIGHT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$4^h\ 32^m$	71.6	98° 41′	98° 45′.3	
	71.7	44		
	71.7	51		
Mark A	—	358 18	358 15.0	N. 79° 29′.7 E.
		6		
		21		
4 35	71.7	98 41	98 45.3	
	71.7	44		
	71.7	51		
Mark A	—	358 21.5	358 18.7	79 33.4
		10.5		
		24		
			Mean	N. 79 31.6 E.

Magnetical azimuth of mark A, N. 79° 32′.8 E.

Horizontal intensity. Experiments of vibration.

1856. August 26, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$10^h\ 47^m\ 32^s.8$	300	$11^h\ 0^m\ 39^s.0$	$13^m\ 6^s.2$
10	47 59.0	310	1 5.2	6.2
20	48 25.0	320	1 31.4	6.4
30	48 51.0	330	1 58.0	7.0
40	49 17.0	340	2 24.0	7.0
50	49 43.5	350	2 50.5	7.0
100	51 54.5	200	10 56 17.0	
				13 6.63

Extreme scale readings.

0	10.0	50.0
100	14.0	46.0
200	16.0	44.0
300	18.0	42.0
350	20.0	40.0

Temperature 76° F.

Time of 1 vibration $2^s.6221$.

1856. August 26, A. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$11^h\ 4^m\ 59^s.0$	300	$11^h\ 18^m\ 5^s.0$	$13^m\ 6^s.0$
10	5 25.0	310	18 32.0	7.0
20	5 51.0	320	18 57.2	6.2
30	6 18.0	330	19 23 8	5.8
40	6 44 0	340	19 50 0	8.0
50	7 10.0	350	20 16.0	6.0
100	9 20.8	200	13 43.0	
				13 6.17

Extreme scale readings.

0	14.0	46.0
100	16.0	44.0
200	19.0	41.0
350	22.0	38.0

Temperature 76° F.

Time of 1 vibration $2^s.6206$.

Horizontal intensity. Experiments of vibration.

1856. August 26, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	11h 25m 15s.0	300	11h 38m 21s.0	13m 6s.0
10	25 41.0	310	38 47.0	6.0
20	26 7.0	320	39 13 5	6 5
30	26 33.2	330	39 40.0	6.8
40	26 59.0	340	40 5.8	6.8
50	27 26.0	350	40 32.0	6.0
100	29 36.8	200	33 58.8	
				13 6.35

Extreme scale readings.

0	20.0	39.0
100	22.0	38.0
200	24.0	36.0
300	25.0	35.0
350	25.5	35.5

Temperature 75°.6 F.

Time of 1 vibration 2s.6212.

Horizontal intensity. Experiments of vibration.

1856. August 26, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	11h 43m 2s.8	300	11h 56m 9s.0	13m 6s.2
10	43 28.8	310	56 35.0	6.2
20	43 54.5	320	57 1.0	6.5
30	44 21.0	330	57 28.0	7.0
40	44 47.3	340	57 53.8	6.5
50	45 14.0	350	58 20.0	6.0
100	47 25.0	200	51 46.5	
				13 6.40

Extreme scale readings.

0	18.0	41.0
50	20.0	39 5
100	20.3	39.0
200	22.0	38.0
300	23.0	36.0

Temperature 75°.0 F.

Time of 1 vibration 2s.6213.

Magnetic inclination.

1856. August 26, $3^h\ 30^m$ P. M. Needle No. 2. A. South pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
43° 21′ 36	42° 34′ 48	42° 41′ 35	42° 0′ 41 54	139° 57′ 39	140° 18′ 1	138° 52′ 35	139° 24′ 6
43 28.5	42 41.0	42 38.0	41 57.0	139 48.0	140 9.5	138 43.5	139 15.0
43 4.7		42 17.5		139 58 7		138 59.3	
42 41.1				139 29.0			
41 36.1							

1856. August 26, $3^h\ 30^m$ P. M. Needle No. 2. A. North pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
136° 28′ 11	136° 25′ 7	136° 19′ 4	136° 27′ 11	45° 1′ 14	44° 20′ 30	45° 21′ 36	44° 24′ 38
136 19.5	136 16.0	136 11.5	136 19.0	45 7.5	44 25.0	45 28.5	44 31.0
136 17.7		136 15.3		44 46.2		44 59.8	
136 16.5				44 53 0			
44 18.3							

1856. August 26, $6^h\ 0^m$ P. M. Needle No. 1. A. North pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
44° 43′ 55	43° 48′ 44 3	46° 7′ 20	45° 5′ 20	138° 30′ 13	138° 41′ 23	138° 13′ 137 53	138° 23′ 5
44 49.0	43 55.5	46 13.5	45 12.5	138 21.5	138 32.0	138 3.0	138 14.0
44 22.2		45 43.0		138 26.7		138 8.5	
45 2.6				138 17.6			
43 22.5							

1856. August 26, $6^h\ 0^m$ P. M. Needle No. 1. A. South pole.

CIRCLE EAST.				CIRCLE WEST.			
Face west.		Face east.		Face west.		Face east.	
46° 8′ 20	45° 3′ 18	40° 34′ 49	39° 47′ 40 3	136° 33′ 17	136° 33′ 17	141° 5′ 140 47	141° 12′ 140 53
46 14.0	45 10.5	40 41.5	39 55.0	136 25.0	136 25.0	140 56.0	141 2.5
45 42.2		40 18.2		136 25.0		140 59.2	
43 0.2				138 42.1			
42 9.1							

OBSERVATIONS AT SAN ANDRES CHALCHECOMULA.

Description of Station No. IV.—The town of San Andres is situated in a plain at the foot of the Peak of Orizaba, and this volcano rises, to the east of it at a distance of about ten miles, to the height of 10,000 English feet above the plain, which is elevated 7,800 English feet above the level of the Mexican Gulf.

The instruments were mounted in the yard of the house of Mr. Canto. The azimuth of a very distant tree (A) was originally determined by observations of the sun, but after the declinometer had been mounted this tree was obscured by fog, and the magnetic azimuth of another, nearer mark (B), having nearly the same direction as A, was determined. Afterwards the angle between A and B was measured and found A 32′.3 to the right of B. This quantity has to be *added* to the circle readings of B to get the corresponding readings for the mark A.

Deflections have not been observed at this station.

Station No. IV. San Andres.

Latitude 18° 59′. Longitude 97° 15′ W. of Greenwich.

Absolute magnetic declination. True azimuth of the mark A.

1856. September 17, A. M. Small theodolite.

Circle to the left.			Circle to the right.		
Object.	Chronometer.	Circle reading.	Object.	Chronometer.	Circle reading.
⊙ Ist limb	$1^h\ 52^m\ 13^s$	266° 18′ 3 6	⊙ Ist limb	$2^h\ 5^m\ 17^s$	267° 28′ 14 18.5
⊙ IId limb	54 24	265 52 37 41	⊙ IId limb	6 42	267 1 266 47 51
Mark A	———	167 30 33 27	Mark A	———	167 24 27.5 21.5
Mark A	———	167 29 32 26	Mark A	———	167 24 28 22
⊙ Ist limb	2 0 47	267 8.5 266 53.5 58.5	⊙ Ist limb	2 11 10	268 3 267 48.5 52
⊙ IId limb	2 50	266 45.5 31 35	⊙ IId limb	12 46	267 37.5 23 25.5

Altitudes of the sun, for the determination of time.

1856. September 17, A. M. Small theodolite.

CIRCLE TO THE LEFT.			CIRCLE TO THE {LEFT.[2] RIGHT.		
Sun's limb.	Chronometer.	Circle reading.	Sun's limb.	Chronometer.	Circle reading.
Upper. D.[1]	2h 21m 18s	330° 20′	Lower. R.	2h 34m 46s	33° 10′
Upper. D.	21 57	10	Lower. R.	35 34	20
Upper. D.	22 38	0	Lower. R.	36 22	30
Lower. D.	2 23 36	330 20	Upper. D.	2 42 48	35 30
Lower. D.	24 14	10	Upper. D.	43 33	40
Lower. D.	24 57	0	Upper. D.	44 15	50
Upper. R.	2 32 32	33 10	Lower. D.	2 45 48	35 40
Upper. R.	33 13	20	Lower. D.	46 37	50
Upper. R.	33 53	30	Lower. D.	47 22	36 0

Temperature of air 65°.5. Barometer 581.5mm. Attached thermometer 69° 0.

Absolute magnetic declination. Altitudes of the sun, for the determination of time.

1856. September 18, A. M. Small theodolite.

CIRCLE TO THE LEFT.			CIRCLE TO THE RIGHT.		
Sun's limb.	Chronometer.	Circle reading.	Sun's limb.	Chronometer.	Circle reading.
Upper	1h 57m 24s	335° 10′	Upper	2h 4m 17s	25° 40′
Upper	58 5	0	Upper	5 0	50
Upper	58 48	334 50	Upper	5 43	26 0
Lower	1 59 41	335 10	Lower	2 6 33	25 40
Lower	2 0 21	0	Lower	7 11	50
Lower	1 2	334 50	Lower	7 57	26 0

Temperature of air 64°.3. Barometer 582.1mm. Attached thermometer 67°.0.

Zero-point of the scale of the collimating magnet.

1856. September 17, A. M. Declinometer.

Chronometer.	Scale.	Chronometer.	Scale.	Chronometer.	Scale.	Means.	
6h 10m	71.9	6h 15m	75.7	6h 19m	72.6	71.6	
	71.5		75.7		72.4	75.7	
R	71.4	D	75.8	R	72.6	72.5	73.9
6 23	76.5	6 27	72.7	6 33	76.1	76.6	74.3
	76.6		72.3		76.2	72.5	74.5
D	76.6	R	72.4	D	76.4	76.2	74.4
6 37	73.5	6 41	75.6	6 47	72.7	73.5	74.6
	73.5		75.8		72.7	75.8	74.7
R	73.5	D	75.9	R	72.8	72.7	74.4
						Mean	74.4

[1] D. denotes direct, R. reflected observations.

[2] Between 2h 36m and 2h 42m the instrument was reversed.

Magnetic azimuth of the mark A.

1856. September 17, P. M. Theodolite and declinometer.

CIRCLE TO THE RIGHT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$6^h\ 52^m$	74.5	280° 24′	280° 16′.2	
	74.4	9.5		
R	74.4	15		
Mark B	———	89 2	89 4.3	N. 10° 39′.6 W.
		1		
		10	+ 32.3	
Mark B	———	89 1	89 4.0	10 44.2
		1	+ 32.3	
		10	280 20.5	
7 3	74.4	280 28.5		
	74.4	13		
R	74.4	20		
			Mean	N. 10 41.9 W.

Absolute magnetic declination. Magnetical azimuth of Mark A.

1856. September 17, P. M. Theodolite and declinometer.

CIRCLE TO THE LEFT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$7^h\ 8^m$	74.4	280° 23′	280° 15′.7	
	74.4	9		
R	74.5	15		
Mark B	———	88 58.5	89 1.3	N. 10° 42′.1 W.
		59.5		
		89 6	+ 32.3	
Mark B	———	88 57.5	89 1.3	
		89 0		
		89 6.5	+ 32.3	10 35.6
7 15	74.5	280 18	280 9.2	
	74.4	2.5		
R	74.5	7		
			Mean	N. 10 38.9

Magnetical azimuth of mark A, N. 10° 40′.4 W.

Horizontal intensity. Experiments of vibration.

1856. September 17, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$7^h\ 44^m\ 41^s.8$	300	$7^h\ 57^m\ 48^s.0$	$13^m\ 6^s.2$
10	45 7.9	310	58 14.4	6.5
20	45 34.0	320	58 40.8	6.8
30	46 0.4	330	59 7.0	6.6
40	46 26.8	340	59 33.3	6.5
50	46 52.8	350	59 59.2	6.4
100	49 3.8	200	53 26.4	
				13 6.50

Extreme scale readings.

0	20.0	40.0
100	22.0	38.0
200	23.0	37.0
300	21.0	35.0
350	24.5	35.0

Temperature 71°.9 F.

Time of 1 vibration $2^s.6217$.

Horizontal intensity. Experiments of vibration.

1856. September 17, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	8h 3m 29s.8	300	8h 16m 36s.1	13m 6s.3
10	3 55.6	310	17 2.3	6.7
20	4 22 0	320	17 28 8	6 8
30	4 48.2	330	17 54 8	6 6
40	5 14 4	340	18 21 2	6.8
50	5 40 8	350	18 47 2	6.4
100	7 51.8	200	12 13.6	
				13 6.60

Extreme scale readings.

0	12.0	48.0
100	15.0	45.0
200	17.0	43.0
350	20.5	39 5

Temperature 71°.8 F.

Time of 1 vibration 2s.6220.

1856. September 17, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 400 vibrations.
0	8h 25m 5s.2	400	8h 42m 34s.0	17m 28s.8
10	25 31.4	410	43 0.2	28.8
20	25 57 5	420	43 26 6	29 1
30	26 24.0	430	43 52 8	28.8
40	26 49 9	440	44 19 2	29.3
50	27 16 2	450		
100	29 27.5	300	38 11.0	
				17 28.96

Extreme scale readings.

0	13 0	47.0
100	17.0	43.0
300	20 0	39.5
440	23.0	37.0

Temperature 68°.7 F.

Time of 1 vibration 2s.6224.

1856. September 17. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	9h 17m 40s.2	300	9h 30m 46s.8	13m 6s.6
10	18 6 4	310	31 13.1	6 7
20	18 33.0	320	31 39 4	6.4
30		330	32 5.6	
40	19 25 0	340	32 31.6	6 6
50	19 51.3	350	32 58.0	6.7
100	22 2.4	200	26 25.0	
				13 6.60

Extreme scale readings.

0	16.0	44.0
100	18 7	41.3
200	20 2	39 8
350	22 8	37.2

Coefficient of torsion.

Torsion circle.	Scale.
300°	302.8
210	299.4
30	306.7
300	303.0

Temperature 66°.0 F. Time of 1 vibration 2s.6220.

Magnetic inclination.

1856. September 18, 8h A. M. Needle No. 1. A. North pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
44° 36′	45° 56′	44° 45′	45° 35′	136° 37′	136° 18′	137° 25′	137° 30′
45 16.0		45 10.0		136 27.5		137 27.5	
45 13.0				136 57.5			
44 7.7							

1856. September 18, 8h A. M. Needle No. 1. A. South pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
139° 5′	139° 20′	140° 0′	140° 27′	40° 53′	42° 0′	42° 22′	42° 47′
139 12.5		140 13.5		41 26.5		42 34.5	
139 43.0				42 0.5			
41 8.7							

NOTE.—In these observations only one vernier of the dip circle was read.

OBSERVATIONS AT MIRADOR.

Description of Station No. V.—Mirador is a large sugar estate, situated on the eastern foot of the high volcanic ridge, which connects the Peak of Orizaba and the Coffre of Perote. Its elevation above the level of the sea is about 2,400 English feet. The soil is compact red clay, containing some iron.

The instruments were mounted under the veranda (porch) of the house of the proprietor, MR. SATORIUS, about 10 feet to the east of the entrance.

A distant tree, bearing E. by S. (magn.) was used for a mark at the determination of absolute declination.

STATION No. V. MIRADOR.

Latitude 19° 13′. Longitude 96° 37′ W. of Greenwich.

Absolute magnetic declination. True azimuth of the mark A.

1856. October 10, A. M. Small theodolite.

CIRCLE TO THE LEFT.			CIRCLE TO THE RIGHT.		
Object.	Chronometer.	Circle reading.	Object.	Chronometer.	Circle reading.
Mark A	———	89° 19′	Mark A	———	89° 16′
		20			18.5
		28			25
⊙ Ist limb	0h 37m 8s	78 52.5	⊙ Ist limb	0h 47m 0s	79 40
		55			40.5
		79 5			51.5
⊙ IId limb	0 39 17	78 33	⊙ IId limb	0 49 0	79 19.5
		33			20
		43			29.5
Mark A	———	89 19	Mark A	———	89 14.5
		20			18.5
		29.5			25

Altitudes of the sun for the determination of time.

1856. October 10, A. M. Small theodolite.

Sun's limb.	Chronometer.	Circle reading.	Sun's limb.	Chronometer.	Circle reading.
Upper. D.	2h 48m 8s	324° 10′	Lower. R.	2h 56m 15s	36° 0′
Upper. D.	48 52	0	Lower. R.	57 0	10
Upper. D.	49 41	323 50	Lower. R.	57 46	20
Lower. D.	2 50 38	324 10	Upper. D.	3 0 33	321 30
Lower. D.	51 22	0	Upper. D.	1 21	20
Lower. D.	52 9	323 50	Upper. D.	2 8	10
Upper. R.	2 53 41	36 0	Lower. D.	3 3 4	321 30
Upper. R.	54 29	10	Lower. D.	3 52	20
Upper. R.	55 12	20	Lower. D.	4 40	10

Temperature of air 71°.0. Barometer 695.7mm. Attached thermometer 71°.5.

Zero-point of the scale of the collimating magnet.

1856. October 10, A. M. Declinometer.

Chronometer.	Scale.	Chronometer.	Scale.	Chronometer.	Scale.	Means.	
0h 44m	71.2	0h 48m	76.9	0h 51m	71.2	71.2	
	71.2		77.0		71.1	77.0	
R	71.2	D	77.1	R	71.2	71.2	74.1
0 54	77.5	0 58	71.2	1 1	76.2	77.5	74.2
	77.5		71.2		76.3	71.2	74.2
D	77.4	R	71.2	D	76.3	76.3	74.0
1 4	71.8	1 8	77.0			71.8	73.9
	71.8		77.0			77.0	74.2
R	71.9	D	77.0				
						Mean	74.1

Absolute magnetic declination. Magnetical azimuth of the mark A.

1856. October 10, A. M. Theodolite and declinometer.

CIRCLE TO THE RIGHT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$1^h\ 16^m$	74.1	182° 2′.5	182° 1′.2	
	74.1	5		
D	74 1	181 56		
Mark A	—	103 48.5	103 51.5	N. 101° 50′.3 E.
		51		
		55		
Mark A	—	103 48.5	103 50 8	101 49.3
		50		
		54		
1 28	74 0	182 2.5	182 1.5	
	74 1	5		
D	74.0	181 57		
			Mean	N. 101 49.8 E.

1856. October 10. Theodolite and declinometer.

CIRCLE TO THE LEFT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$1^h\ 23^m$	74.2	182° 6′.5	182° 7′.3	
	74 3	8.0		
D	74 2	1.5		
Mark A	—	103 53.5	103 56.0	N. 101° 48′.7 E.
		55.5		
		59.0		
Mark A	—	103 53.0	103 55.8	101 50.5
		56 0		
		58.5		
1 38	74.1	182 6.0	182 5.3	
	74.1	8.5		
D	74.1	1.5		
			Mean	N. 101 49.6 E.

Magnetical azimuth of the mark A, N. 101° 49′.7 E.

Horizontal intensity. Experiments of vibration.

1856. October 9, A. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$5^h\ 37^m\ 22^s.4$	300	$5^h\ 50^m\ 33^s.2$	$13^m\ 10^s.8$
10	37 48.8	310	50 59.6	10.8
20	38 15 0	320	51 26.1	11.1
30	38 41.2	330	51 52.7	11.5
40	39 7.6	340	52 18 8	11.2
50	39 34.0	350	52 45 6	11.6
100	41 45.6	200	46 9.2	
				13 11 17

Extreme scale readings.

0	19.0	41.0
200	22.3	37.7
350	24 3	35.7

Temperature 76°.0 F.

Time of 1 vibration $2^s.6372$.

Horizontal intensity. Experiments of vibration.

1856. October 9, A. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 200 vibrations.
0	$9^h\ 0^m\ 43^s.6$	200	$9^h\ 9^m\ 31^s.6$	$8^m\ 48^s\ 0$
10	1 9 8	210	9 57 9	48 1
20	1 36 3	220	10 24.6	48.3
30	2 2.8	230	10 50.6	47 8
40	2 29 2	240	11 17.0	47 8
50	2 55 6	250	11 43 2	47.6
100	5 7.6	260	12 9 6	
				8 47 93

Extreme scale readings.

0	17 0	43 0
100	19.0	41 0
250	22.0	38.0

Temperature 75°.5 F.

Time of 1 vibration $2^s.6396$.

1856. October 9, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$10^h\ 46^m\ 5^s.8$	300	$10^h\ 59^m\ 16^s\ 9$	$13^m\ 11^s.1$
10	46 32 1	310	59 43.1	11 0
20	46 58.4	320	11 0 9.4	11.0
30	47 25.0	330	0 35 8	10.8
40	47 51 3	340	1 2 2	10 9
50	48 17.5	350	1 28.8	11.3
100	50 29.2	200	10 54 53.2	
				13 11.02

Extreme scale readings.

0	22.5	37 5
100	24.0	36.0
200	25.0	35.0
350	26 0	34.0

Temperature 72°.0 F.

Time of 1 vibration $2^s.6367$.

Horizontal intensity. Experiments of vibration.

1856. October 9, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 204 vibrations.
0	$11^h\ 4^m\ 39^s.8$	204	$11^h\ 13^m\ 38^s\ 0$	$8^m\ 58^s.2$
10	5 6 0	214	14 4 2	58.2
20	5 32.8	224	14 30 6	57 8
30	5 59.0	234	14 57 0	58 0
40	6 25 8	244	15 23 2	57 4
50	6 51.8	254	15 49 4	57.6
104	9 14.0	264	16 15 8	
				8 57 84

Extreme scale readings.

0	21.0	39 0
104	22.7	37.3
264	24.0	36 0

Temperature 71°.6 F.

Time of 1 vibration $2^s.6366$.

Experiments of deflection. Distance 1.3 foot.

1856. October 10, A. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
W.	N.	263° 26′ 10″	26′ 10″		76°.2
		26 10			
"	N.	263 26 0	25 55		
		25 50			
"	N.	263 24 0	24 0		
		0			
"	S.	270 18 40	18 45		
		18 50		6° 53′ 21″	
"	S.	270 18 40	18 40		
		18 40			
"	S.	270 18 40	18 45		
		18 50			
E.	N.	270 13 40	13 35		
		13 30			
"	N.	270 13 30	13 30		
		13 30			
"	N.	270 13 45	13 47		
		13 50			
"	S.	263 27 50	27 45	6 46 34	
		27 40			
"	S.	263 27 50	27 45		
		27 40			
"	S.	263 25 50	25 40		
		25 30			77.6
			Mean	6 49 57	

Horizontal intensity. Experiments of deflections. Distance 1 foot.

1856. October 10. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
W.	S.	274°-25′ 0″	25′ 0″		77°.0
		0			
"	S.	274 25 5	25 2		
		0			
"	S.	274 25 45	25 42		
		25 40		15° 8′ 53″	
"	N.	259 16 35	16 35		
		16 35			
"	N.	259 16 25	16 20		
		16 15			
"	N.	259 16 10	16 10		
		16 10			
E.	S.	259 21 0	21 0		
		21 0			
"	S.	259 20 40	20 38		
		20 35			
"	S.	259 20 30	20 30		
		20 30			
"	N.	274 9 25	9 22	14 50 2	
		9 20			
"	N.	274 9 20	9 15		
		10			
"	N.	274 13 45	13 48		
		13 50			77
			Mean	14 59 27	

Magnetic inclination.

1856. October 11, 8h A. M. Needle No. 1. A. North pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
42° 42′	43° 29′	43° 52′	44° 31′	133° 0′	136° 1′	136° 20′	136° 23′
43 5.5		44 11.5		136 0.5		136 21.5	
43 38.5				136 11.0			
43 43.7							

1856. October 11, 8h A. M. Needle No. 1. A South pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
136° 1′	135° 27′	136° 13′	136° 18′	43° 31′	44° 17′	43° 23′	44° 8′
135 44.0		136 15.5		43 54.0		43 45.5	
135 59.8				43 49.8			
43 55.0							

NOTE.—In these observations only one vernier of the dip circle was read.

Magnetic inclination.

1856. October 10, 1h 50m P. M. Needle No. 2. A. South pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
41° 57′	42° 44′	42° 15′	43° 11′	137° 48′	137° 17′	137° 44′	137° 12′
42 12	43 0	30	25	37	6	32	1
42 4.5	42 52.0	42 22.5	43 18.0	137 42.5	137 11.5	137 38.0	137 6.5
42 28.2		42 50.2		137 27.0		137 22.2	
42 39.2				137 24.6			
42 37.3							

1856. October 10, 1h 50m P. M. Needle No. 2. A. North pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
136° 16′	136° 2′	134° 41′	134° 28′	43° 34′	44° 31′	46° 0′	46° 46′
1	135 46	26	12	48	46	14	47 1
136 8.5	135 54.0	134 33.5	134 20.0	43 41.0	44 38.5	46 7.0	46 53.5
136 1.2		134 26.8		44 9.8		46 30.2	
135 14.0				45 20.0			
45 3.0							

OBSERVATIONS AT THE CITY OF MEXICO.

Description of Station No. VI.—The instruments were mounted on the arched roof of the church in the Convent San Augustin. This is the same place where BARON VON HUMBOLDT made his observations about fifty-seven years ago. The roof is entirely of bricks, and there is no iron within fifty feet of the station, farther off are some iron railings, etc.

The station is 75 feet above the ground, or 7,550 English feet above the level of the sea.

A church steeple, about fifteen miles west of the station, was used for a mark (A) at the determination of absolute declination.

STATION NO. VI. MEXICO, CONVENT SAN AUGUSTIN.

Latitude 19° 26′. Longitude 99° 5′ W. of Greenwich.

Absolute magnetic declination. True azimuth of the mark A.

1856. December 11, A. M. Small theodolite.

CIRCLE TO THE LEFT.			CIRCLE TO THE RIGHT.		
Object.	Chronometer.	Circle reading.	Object.	Chronometer.	Circle reading.
Mark A	———	150° 55′	Mark A	———	150° 35′
		151 0			38
		0.5			40
⊙ IId limb	$7^h\ 55^m\ 13^s$	11 51	⊙ Ist limb	$8^h\ 19^m\ 37^s$	15 24
		40 5			16
		12 2			37
⊙ Ist limb	57 30	12 42	⊙ IId limb	8 21 22	14 59
		34			51
		54			15 12.5
⊙ Ist limb	59 12	12 54	Mark A	———	150 44
		44.5			49
		13 7 5			50 5
⊙ IId limb	8 0 23	12 29	Mark A	———	150 45
		20			52
		41			51
Mark A	———	150 55	⊙ Ist limb	8 29 14	16 50 5
		151 1			40.5
		1			17 2
Mark A	———	150 51	⊙ IId limb	30 33	16 29
		57			20
		55			42
⊙ Ist limb	8 7 33	13 56 5	Mark A	———	150 43
		47 5			50
		14 8			49
⊙ IId limb	8 8 44	13 31	———	———	———
		22 5			
		43.5			

NOTE—The chronometer was $+0^m\ 43^s.5$ slow of mean Mexican time. Its daily rate was $+3^s.6$ (losing).

Zero point of the scale of the collimating magnet.

1856. December 11, A. M. Declinometer.

Chronometer.	Scale.	Chronometer.	Scale.	Chronometer.	Scale.	Chronometer.	Scale.
$9^h\ 57^m$	74.7	$4^h\ 59^m$	72.9	$10^h\ 2^m$	74.7	$10^h\ 4^m$	72.9
D	74.6	R	73.0	D	74.7	R	73.1
	74.6		73.0		74.6		73.1
Mean	74.6		73.0		74.7		73.0

Zero point 73.8 on the scale.

Absolute magnetic declination. Magnetical azimuth of the mark A.

1856. December 11, A. M. Theodolite and declinometer.

CIRCLE TO THE LEFT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$10^h\ 7^m$	73.8	79° 42′.5	79° 50′.2	
	73.8	46.5		
	73 8	80 1.5		
Mark A	———	153 24	153 28.0	N. 106° 22′.2 W.
		31		
		29		
Mark A	———	153 30.5	153 33.5	106 24.3
		36		
		34		
10 17	73.7	79 51	79 57.8	
	73.6	54		
	73.6	80 8.5		
10 19	73 8	79 51	79 57.7	
	73.7	54		
	73.7	80 8		
Mark A	———	153 32	153 35.0	106 22.7
		38		
		35		
			Mean	N. 106 23.1 W.

1856. December 11, A. M. Theodolite and declinometer.

CIRCLE TO THE RIGHT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
$10^h\ 23^m$	73.7	79° 39′	79° 46′.3	
	73.7	42		
	73 7	58		
Mark A	———	153 21	153 25.0	N. 106° 21′.3 W.
		28		
		26		
Mark A	———	153 22	153 25 8	106 22.7
		28.5		
		27		
10 30	73.9	79 42	79 48.5	
	74.0	43.5		
	74.0	80 0		
			Mean	N. 106 22 0 W.

Magnetical azimuth of the mark A, N. 106° 22′.6 W.

Horizontal intensity. Experiments of vibration.

1856. December 10, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	1h 48m 7s.1	300	2h 1m 17s 0	13m 9s.9
10	48 33 6	310	1 43.5	9.9
20	48 59 8	320	2 9.4	9.6
30	49 26.5	330	2 35.8	9 3
40	49 52.5	340	3 2.0	9.5
50	50 18.8	350	3 28 3	9.5
100	52 30.4	200	1 56 53.5	
				13 9 62

Extreme scale readings.

0	21.4	38.6
50	22.2	37.8
100	22.8	37.2
200	24.0	36.0
350	25.3	34.7

Temperature 68°.2 F.

Time of 1 vibration 2s.6321.

1856. December 10, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	2h 6m 24s.9	300	2h 19m 34s.4	13m 9s.5
10	6 51.0	310	20 0.4	9.4
20	7 17.4	320	20 26.8	9.4
30	7 43.5	330	20 53.1	9.6
40	8 9 6	340	21 19.7	10.1
50	8 36.6	350	21 46.0	9.4
100	10 48.0	200	15 11.4	
				13 9.57

Extreme scale readings.

0	18 0	42.0
50	19 2	40.8
100	20 1	39.9
200	21 7	38.3
350	23.5	36.5

Temperature 68°.6 F.

Time of 1 vibration 2s.6319.

1856. December 10, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	1h 12m 11s.0	300	1h 25m 21s.6	16m 10s.6
10	12 37.5	310	25 47.8	10 3
20	13 4 0	320	26 14 2	10 2
30	13 30.2	330	26 40 6	10.4
40	13 56 5	340	27 7 0	10.5
50	14 23.2	350	27 33.4	10 2
100	16 34 5	200	20 58.0	
				13 10 37

Extreme scale readings.

0	17.0	43 0
200	20 3	39.7
350	22.0	38.0

Temperature 69°.5 F.

Time of 1 vibration 2s.6346.

Horizontal intensity. Experiments of vibration.

1856. December 10, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	$1^h\ 31^m\ 13^s.5$	300	$1^h\ 44^m\ 23^s\ 6$	$13^m\ 10^s.3$
10	31 39.6	310	44 49.8	10.2
20	32 6 0	320	45 16.0	10.0
30	32 32.7	330	45 42.4	9.7
40	32 58.8	340	46 8.7	9 9
50	33 25.1	350	46 35.3	10.2
100	35 37.0	200	40 0.0	
				13 10 10

Extreme scale readings.

0	14.5	45.5
100	16.0	44 0
200	18.2	41.8
350	21.0	39.0

Temperature 68°.8 F.

Time of 1 vibration $2^s.6337$.

Experiments of deflection. Distance 1 foot.

1856. December 10. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
E.	W.	157° 16′ 20″	16′ 0″		68°.5
		15 40			
"	W.	157 16 30	16 5	14° 45′ 30″	
		15 40			
"	E.	172 1 50	1 30	45 25	
		1 10			
"	E.	172 1 45	1 30		
		1 15			
W.	W.	172 14 25	14 7		
		13 50			
"	W.	172 13 50	13 25	15 0 22	
		13 0			
"	E.	157 14 10	13 45	14 59 32	
		13 20			
"	E.	157 14 5	13 53		
		13 40			
E.	E.	171 58 50	58 30		
		58 10			
"	W.	157 17 40	17 20	14 41 10	
		17 0			
W.	E.	157 16 15	15 52	14 54 0	
		15 30			
"	W.	172 10 0	9 52		68.8
		9 45			
			Mean	14 51 0	68.6

Horizontal intensity. Experiments of deflections.

1856. December 10. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
E.	E.	168° 5′ 45″	5′ 25″		67°.9
		5 5			
"	E.	168 05 55	5 32	6° 44′ 17″	
		5 10			
"	W.	161 22 0	21 40	43 45	
		21 20			
"	W.	161 21 30	21 15		
		21 0			
W.	E.	161 20 50	20 30	6 49 20	
		20 10			
"	E.	161 21 30	21 12	48 33	
		20 55			
E.	W.	161 21 50	21 32		
		21 15			
"	E.	168 1 40	1 45	6 40 13	
		1 50			
W.	W.	168 6 15	5 48	45 21	
		5 20			
"	E.	161 20 40	20 27		
		20 15			
"	W.	168 10 0	9 50		
		9 40			
"	W.	168 10 0	9 45		67.9
		9 30			
			Mean	6 45 15	67.9

Magnetic inclination.

1856. December 17, 0^h 50^m P. M. Needle No. 1. A. South pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
41° 55′	39° 36′	41° 39′	39° 50′	139° 27′	137° 31′	139° 36′	137° 24′
42 11	50	54	40 8	10	16	18	5
42 3.0	39 43.0	41 46 5	39 59.0	139 18.5	137 23.5	139 27.0	137 14.5
40 53.0		40 52.8		138 21.0		138 20.8	
40 52.9				138 20.9			
41 16.0							

1856. December 17, 1^h 40^m P. M. Needle No. 1. A. North pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
139° 50′	137° 42′	138° 41′	136° 37′	41° 52′	39° 51′	42° 17′	40° 25′
34	24	24	20	42 9	40 5	34	41
139 42.0	137 33.0	138 32.5	136 28.5	42 0.5	39 58.0	42 25.5	40 33.0
138 37.5		137 30.5		40 59.2		41 29.2	
138 4.0				41 14.2			
41 35.1							

Magnetic inclination.

1856. December 17, 1^h 50^m P. M. Needle No. 2. A. North pole.

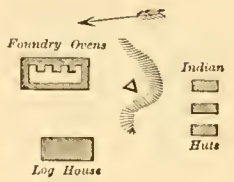
CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
41° 37′ 54	39° 43′ 40 0	41° 46′ 42 3	39° 55′ 40 11	139° 14′ 138 56	137° 14′ 136 56	139° 10′ 138 53	137° 14′ 136 56
41 45.5	39 51.5	41 54.5	40 3.0	139 5.0	137 5.0	139 1 5	137 5.0
40 48.5		40 58.7		138 5.0		138 3.2	
40 53.6				138 4.1			
41 24.7							

1856. December 17, 2^h 30^m P. M. Needle No. 2. A. South pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
139° 34′ 18	137° 29′ 12	139° 16′ 1	137° 24′ 7	42° 11′ 25	40° 26′ 42	41° 50′ 42 5	40° 8′ 23
139 26.0	137 20.5	139 8.5	137 15.5	42 18.0	40 34.0	41 57.5	40 15.5
138 23.2		138 12.0		41 26.0		41 6.5	
138 17.6				41 16.2			
41 29.3							

OBSERVATIONS AT RANCHO TLAMACAS.

Description of Station No. VIII.[1]—The magnetic station was established at the sulphur foundry, called Rancho Tlamacas, on a small depression of the ground between the foundry ovens (to the north) and three Indian huts (to the south and southwest.)



The height of the station above the level of the Mexican Gulf is 12,750 English feet.

A pointed rock on the northeast side of the volcanic cone, a little below the limit of perpetual snow, was used for a mark (A) in the determination of absolute declination.

STATION NO. VIII. RANCHO TLAMACAS.

Latitude 19° 3′. Longitude 98° W. of Greenwich.

Absolute magnetic declination. True azimuth of the mark A.

1857. January 25, P. M. Small theodolite.

CIRCLE TO THE LEFT.			CIRCLE TO THE RIGHT.		
Object.	Chronometer.	Circle reading.	Object.	Chronometer.	Circle reading.
Mark A	———	179° 59′.5	Mark A	———	180° 15′.5
		61.5			17.0
		57.0			12.5
Mark A	———	179 59.5	Mark A	———	180 15.0
		60.5			17.0
		57.0			12.5
⊙ Ist limb	$4^h\ 16^m\ 51^s$	268 42 0	⊙ Ist limb	$4^h\ 30^m\ 44^s$	270 35.0
		26.0			18.0
		35.0			26.5
⊙ IId limb	19 21	268 26 5	⊙ IId limb	32 6	270 11.0
		10 0			269 54.0
		19.5			270 2.0
⊙ Ist limb	20 58	269 21.5	⊙ IId limb	33 17	270 19.0
		5.0			2.5
		14.5			12 0
⊙ IId limb	22 37	268 59.5	⊙ Ist limb	34 47	271 2 5
		44.0			270 45.0
		53.0			55.0
Mark A	———	180 7.0	Mark A	———	180 20 0
		10.0			21.0
		6 5			18.0
Mark A	———	180 7.0	Mark A	———	180 20
		10.5			21.5
		6.5			17.5

[1] There has also been made a complete set of magnetical observations at the town of Chalev, in the valley of Mexico (latitude 19° 18′, longitude 98° 51′ west of Greenwich), and this station is called No. VII. The results of these observations only will be given in the following pages, as the record of them was lost.

Absolute magnetic declination. True azimuth of the mark A.

1857. January 26, A. M. Small theodolite.

CIRCLE TO THE RIGHT.			CIRCLE TO THE LEFT.		
Object.	Chronometer.	Circle reading.	Object.	Chronometer.	Circle reading.
Mark A	———	303° 41′.0	Mark A	———	303° 39′.0
		23.3			18.5
		38.5			38.0
Mark A	———	303 41.5	Mark A	———	303 39.0
		23.0			19.0
		38.5			38.5
⊙ Ist limb	7h 50m 54s	276 32 0	⊙ Ist limb	8h 15m 7s	270 28 5
		15.5			11.0
		24.5			22.0
⊙ IId limb	53 11	267 14.0	⊙ Ist limb	16 58	270 42 0
		266 59.9			27.0
		267 6.0			38.0
⊙ Ist limb	56 32	268 13.5	⊙ IId limb	19 0	270 23 0
		267 56.0			7.5
		268 4.0			18.0
⊙ IId limb	58 33	267 52.0	⊙ IId limb.	20 46	270 38.0
		35.5			22.0
		43.0			32 0
Mark A	———	303 44.5	Mark A	———	303 41 5
		25.5			22 0
		40.0			40.0
Mark A	———	303 44.5	Mark A	———	303 42.0
		25.0			23.0
		40.0			39.0

Absolute magnetic declination. Zero-point of the scale of the collimating magnet.

1857. January 25. Declinometer.

Chronometer.	Scale.	Chronometer.	Scale.	Chronometer.	Scale.	Means.	
11h 53m	74.0	11h 57m	77.7	0h 2m	74.0	74.0	
D	74.0	R	77.9	D	73.9	77.8	75 9
	74.0		77.8		73.9	73.9	75.7
0 7	77 2	0 11	73.1	0 16	77.5	77.2	75.3
R	77.2	D	73.1	R	77.4	73.1	75.2
	77.2		73.0		77.4	77.4	75.3
0 20	73.3	0 25	77.4	0 29	73.3	73.2	75.3
D	73.1	R	77.5	D	73.3	77.4	75.3
	73.1		77.4		73 3	73.3	
						Mean	75.4

Absolute magnetic declination. Magnetical azimuth of Mark A.

1857. January 25, P. M. Theodolite and declinometer.

CIRCLE TO THE LEFT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
Mark A	———	323° 45′.0	323° 58′.3	N. 145° 6′.3 E.
		46.0		
		64.0		
0h 46m	75.3	358 54.5	358 52.0	
D	75 4	40.5		
	75.3	61 0		
0 51	75 5	358 53.5	358 51.8	
D	75.4	41.0		
	75.5	61.0		
Mark A	———	323 65.0	323 58.5	154 6.7
		46.5		
		64.0		
Mark A	———	180 1.0	180 2.3	145 5.0
		4.5		
		1.5		
1 6	75.2	214 60.0	214 57.3	
	75.2	56.5		
	75.2	55 5		
1 14	75.5	214 60.0	214 56.3	
	75.5	55.0		
	75.3	54.0		
Mark A	———	180 2.0	180 3.2	145 6.9
		5.5		
		2.0		
			Mean	N. 145 6.2 E.

1857. January 25, P. M. Theodolite and declinometer.

CIRCLE TO THE RIGHT.

Chronometer.	Scale.	Circle reading.	Mean.	Bearing of A.
Mark A	———	179° 57′.0	179° 57′.2	N. 145° 7′.0 E.
		59.5		
		55.0		
1h 22m	75.5	214 54.0	214 50.2	
	75.5	49.0		
	75.5	47.5		
1 24	75.5	214 54 0	214 50 0	
	75.5	49.0		
	75.3	47.0		
Mark A	———	179 59.0	179 58 2	145 8.2
		60 0		
		55.5		
Mark A	———	179 59.0	179 58.3	145 8.8
		60 5		
		55 5		
1 33	75.5	214 53.0	214 49.5	
	75.4	49.0		
	75.3	46.5		
1 37	75 2	214 53.0	214 49.8	
	75.2	49.0		
	75 3	47.5		
Mark A	———	179 59.5	179 59.3	145 9 5
		61.5		
		57.0		
			Mean	145 8.4

Magnetical azimuth of mark A, N. 145° 7′.3 E.

Horizontal intensity. Experiments of vibration.

1857. January 25, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	3h 20m 3s.6	300	3h 33m 13s.8	13m 10s.2
10	20 29.8	310	33 40.2	10.4
20	20 56 2	320	34 6.4	10.2
30	21 22.6	330	34 32.9	10.3
40	21 48.8	340	34 59.3	10.5
50	22 15.2	350	35 25 6	10.4
100	24 27.2	200	28 50.5	
				13 10.33

Extreme scale readings.

0	20.0	40.0
100	21.7	38.3
200	24.0	36 3
350	27.8	31.6

Temperature 11°.5 C.

Time of 1 vibration 2s.6344.

1857. January 25, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	3h 39m 28s.2	300	3h 52m 38s.6	13m 10s.4
10	39 54.4	310	53 4.9	10.5
20	40 20.8	320	53 31.2	10.4
30	40 47.2	330	53 57 6	10.4
40	41 13 4	340	54 23.9	10.5
50	41 40.0	350	54 50.2	10.2
100	43 51.7	200	48 15.2	
				13 10.40

Extreme scale readings.

50	20.0	40.0
200	22 2	37.8
300	23.6	36.4
350	24.2	35.9

Temperature 12°.2 C.

Time of 1 vibration 2s.6347.

1857. January 25, P. M. Vibrating magnet D 3.

No.	Chronometer.	No.	Chronometer.	Time of 300 vibrations.
0	3h 56m 39s.7	300	4h 9m 50s.1	13m 10s.4
10	57 6.2	310	10 16.5	10.3
20	57 32 6	320	10 42.8	10 2
30	57 58.9	330	11 9.2	10.3
40	58 25.3	340	11 35 4	10.1
50	58 51.8	350	12 1.7	9 9
100	4 1 3 3	200	5 27.8	
				13 10.20

Extreme scale readings.

0	19 0	41.0
100	20.7	39.3
200	22 5	37.5
300	23 6	36.2

Temperature 5°.5 C.

Time of 1 vibration 2s.6340.

Experiments of deflection. Distance 1 foot.

1857. January 26, 11h 6m A. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
E.	W.	78° 49′ 0″	48′ 30″		9°.7 C.
		48 0			
"	E.	93 16 10	15 47	14° 27′ 17″	
		15 25			
W.	W.	93 48 50	48 45		
		48 40			
"	E.	78 28 10	27 37	15 21 8	
		27 5			
"	E.	78 28 45	28 17		
		27 50			
"	W.	93 47 45	47 25	15 19 8	
		47 5			
E.	E.	93 16 25	16 7		
		15 50			
"	W.	78 49 0	48 40	14 27 27	
		48 20			9.7
			Mean	14 53 45.0	

Horizontal intensity. Experiments of deflections.

1857. January 26, 11h 25m A. M. Deflecting magnet D 3.

Magnet.	North pole.	Circle reading.	Mean.	2 u.	Temp.
E.	W.	82° 49′ 40″	49′ 30″		9°.7 C.
		49 20			
"	E.	89 23 10	22 45	6° 33′ 15″	
		22 20			
W.	W.	89 33 35	33 12		
		32 50			
"	E.	82 42 20	41 55	6 51 17	
		41 30			
"	E.	82 39 5	38 47		
		38 30			
"	W.	89 33 30	33 10	6 54 23	
		32 50			
E.	E.	89 23 15	22 47		
		22 20			
"	W.	82 46 20	45 50	6 36 57	
		45 20			9.7
			Mean	6 43 58	

Magnetic inclination.

1857. January 25, 9h 45m A. M. Needle No. 2. A. North pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
43° 41′ 52	42° 23′ 36	44° 4′ 15	42° 36′ 47	138° 69′ 58	137° 21′ 5	139° 17′ 1	136° 47′ 31
43 46.5	42 29.5	44 9.5	42 41.5	139 3.5	137 13.0	139 9.0	136 39.0
43 8.0		43 25.5		138 8.2		137 5.4	
43 16.8				138 1.1			
42 37.8							

1857. January 25, 9h 45m A. M. Needle No. 2. A. South pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
138° 39′ 21	136° 63′ 47	138° 35′ 19	136° 51′ 35	43° 45′ 56	41° 54′ 65	44° 12′ 23	42° 2′ 14
138 30.0	136 55.0	138 27.0	136 43.0	43 50.5	41 59.5	44 17.5	42 8.0
137 42.5		137 35.0		42 55.0		43 12.8	
137 38.8				43 3.9			
42 42.6							

1857. January 25, 10h 40m A. M. Needle No. 1. A. South pole.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
44° 7′ 17	41° 59′ 70	43° 48′ 58	41° 34′ 45	138° 53′ 38	136° 68′ 53	138° 69′ 54	137° 38′ 23
44 12.0	42 4.5	43 53.0	41 39.5	138 45.5	137 0.5	139 1 5	137 30.5
43 8.2		42 46.2		137 53.0		138 16.0	
42 57.2				138 4.5			
42 26.4							

1857. January 25, 10h 40m A. M. Needle No. 1. A. North pole.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
138° 54′ 37	137° 26′ 10	138° 24′ 8	136° 43′ 28	43° 57′ 70	41° 37′ 50	43° 34′ 48	41° 22′ 37
138 45.5	137 18.0	138 16.0	136 35.5	44 3.5	41 43.5	43 41.0	41 29.5
138 1.8		137 25.8		42 53.5		42 35.3	
137 43.8				42 44.4			
42 30 3							

RESULTS OF THE MAGNETICAL OBSERVATIONS.

MAGNETIC DECLINATION.

STATION No. I. VERA CRUZ.

Magnetic azimuth of the mark A	N. 52° 19′.8 W.
Astronomical " " "	N. 44 2 9 W.
Magnetic declination, 1856, August 7, at noon	8 16.9 E.

STATION No. II. POTRERO.

Magnetic azimuth of the mark A	N. 83° 2′.8 W.
Astronomical " " "	N. 74 23.6 W.
Magnetic declination, 1856, August 17, 7^h 13^m A. M.	8 39.2 E.

STATION No. III. COCOLAPAM NEAR ORIZABA.

Magnetic azimuth of the mark A	N. 79° 32′.8 E.
Astronomical " " "	N. 88 1.1 E.
Magnetic declination, 1856, August 27, 10^h 8^m A. M.	8 28.3 E.

STATION No. IV. SAN ANDRES CHALCHECOMULA.

Magnetic azimuth of the mark A	N. 10° 40′.4 W.
Astronomical " " "	N. 2 27.6 W.
Magnetic declination, 1856, September 17, 0^h 40^m P. M.	8 12.8 E.

STATION No. V. MIRADOR.

Magnetic azimuth of the mark A	N. 101° 49′.7 E.
Astronomical " " "	N. 109 51.3 E.
Magnetic declination, 1856, October 10, 7^h 12^m A. M.	8 1.6 E.

STATION No. VI. CITY OF MEXICO.

Magnetic azimuth of the mark A	N. 106° 22′.6 W.
Astronomical " " "	N. 97 36.1 W.
Magnetic declination, 1856, December 11, 10^h 19^m A. M.	8 46.5 E.

STATION No. VIII. RANCHO TLAMACAS.

Magnetic azimuth of the mark A	N. 145° 7′.3 E.
Astronomical " " "	N. 153 35.7 E.
Magnetic declination, 1857, January 25, 1^h 19^m P. M.	8 28.4 E.

HORIZONTAL INTENSITY.

The constants K and g for the magnet D 3, which was exclusively used in the experiments of vibrations and deflections, had been determined in 1855 by Mr. CHAS. A. SCHOTT, U. S. Coast Survey, and found:—

Moment of inertia $K = 2.6072$, at temperature 76°.2.

Coefficient of temperature $g = 0.00022$.

The value of *log.* $\pi^2 K$ was computed for the following temperatures:—

At temp. 76° *log.* $\pi^2 K = 1.41047$.
" 50 *log.* $\pi^2 K = 1.41032$.

Change of *log.* $\pi^2 K$ for 1° F., 0.6 units of the 5th decimal.

The observations of deflection at distances of 1 foot and 1.3 feet, and at five different stations, give the value of the induction-coefficient P:—

Station I.	1856, August 7 . . .	$P = +0.0004$
" II.	1856, August 17 . . .	-0.0007
" V.	1856, October 10 . . .	-0.0085
" VI.	1856, December 10 . . .	-0.0037
" VIII.	1857, January 26 . . .	$+0.0118$
	Mean . . .	$P = -0.0001$

This value of P is so small that it was neglected in the computation of the intensity.

The experiments of vibrations and deflections at the same five stations give for the magnetic moment m of magnet D 3.

Station I.	1856, August 7 . .	$m = 0.4952$, temp. 83°
" II.	1856, August 17 . .	0.4945, " 78
" V.	1856, October 9 . .	0.4915, " 74
" VI.	1856, December 10 . .	0.4899, " 69
" VIII.	1857, January 25 . .	0.4895, " 50

The means of the 1st and 2d, and of the 3d and 4th values give:—

1856, August 12 . . . $m = 0.4948$, temperature 80°
1856, November 9 . . . $m = 0.4907$, " 72

Loss of magnetism for ten days 0.00046.[1]

From these the values of m were interpolated for the two stations, at which no experiments of deflections have been made, viz:—

Station III.	August 26	$m = 0.4942$
" IV.	September 17	0.4931

m and X are expressed in feet and grains.

STATION NO. I. VERA CRUZ.

	Time of 1 vibration.	Temp.
August 7.	2s.6258	81°.5
" 7.	.6252	81.5
" 7.	.6254	82.0
" 8.	.6269	84.2
" 8.	.6256	84.3
" 8.	.6262	84.4
Mean	2.6258	83.0
Corr. for rate	+ 2	
T'	= 2.6260	

	Angles of deflection. Distance.	n.	Temp.
August 7.	1 foot	7° 33′ 17″	84°.7
" 7.	1.3 feet	3 25 49	85.0

Horizontal intensity, August 7 and 8.
$X = 7.533$.

STATION NO. II. POTRERO.

	Time of 1 vibration.	Temp.
August 16.	2s.6203	77°.0
" 16.	.6217	78 0
" 17.	.6197	78.0
" 17.	.6192	78.0
T'	= 2.6202	77.8

	Angles of deflection. Distance.	n.	Temp.
August 17.	1 foot	7° 30′ 8″	81°.0
" 17.	1.3 feet	3 24 29	80.7

Horizontal intensity, August 16 and 17.
$X = 7.574$.

[1] Mr. Chas. A. Schott found 1855, September 13, $m = 0.5104$, which gives the loss in 334 days = 0.0156, or the loss in 10 days 0.00047, showing a very regular decrease of the magnetism of D 3.

STATION No. III. COCOLAPAM NEAR ORIZABA.

	Time of 1 vibration.	Temp.
August 26.	$2^s.6221$	76°.0
" 26.	.6206	76 0
" 26.	.6212	75.6
" 26.	.6213	75.0
	$T' = 2.6213$	75.6

No deflections observed.
m assumed 0.4942.

Horizontal intensity, August 26.
$X = 7.579$.

STATION No. IV. SAN ANDRES CHALCHECOMULA.

	Time of 1 vibration.	Temp.
September 17.	$2^s.6217$	71°.9
" 17.	.6220	71.8
" 17.	.6220	66.0
" 17.	.6224	68.7
	$T' = 2.6220$	69.6

No deflections observed.
m assumed 0.4931.

Horizontal intensity, September 17.
$X = 7.589$.

STATION No. V. MIRADOR.

	Time of 1 vibration.	Temp.
October 9.	$2^s.6372$	76°.0
" 9.	.6396	75.5
" 9.	.6367	72.0
" 9.	.6366	71.6
	$T' = 2.6375$	73.6

	Distance.	u.	Temp.
October 9.	1 foot	7° 29′ 44″	77°.0
" 9.	1.3 feet	3 24 58	76.9

Angles of deflection.

Horizontal intensity, October 9.
$X = 7.522$.

STATION No. VI. CITY OF MEXICO.

	Time of 1 vibration.	Temp.
December 10.	$2^s.6321$	68°.2
" 10.	.6319	68.6
" 10.	.6346	69.5
" 10.	.6337	68.8
	$T' = 2.6331$	68.8

	Distance.	u.	Temp.
December 10.	1 foot	7° 25′ 30″	68°.6
" 10.	1.3 feet	3 22 38	67.9

Angles of deflection.

Horizontal intensity, December 10.
$X = 7.576$.

STATION No. VIII. RANCHO TLAMACAS.

	Time of 1 vibration.	Temp.
January 25.	$2^s.6344$	11°.5 C.
" 25.	.6347	12.2 C.
" 25.	.6340	5.5 C.
	$T' = 2.6344$	9.7 C. = 49.5 F.

	Distance.	u.	Temp.
January 25.	1 foot	7° 26′ 52″	9°.7 C.
" 25.	1.3 feet	3 21 59	9.7 C.

Angles of deflection.

Horizontal intensity, January 25.
$X = 7.571$.

MAGNETIC INCLINATION.

STATION No. I. VERA CRUZ.

	Needle No. 1.	Needle No. 2.	Needle No. 2.
A. North pole	45° 0′.1	45° 44′.8	45° 1′.5
A. South pole	43 14.0	42 15.6	42 30.5
Mean	44 7.0	44 0.2	43 46.0

Resulting dip, August 8, 43° 57′.7.

STATION No. II. POTRERO.

	Needle No. 1.	Needle No. 2.
A. North pole	43° 11′.8	44° 13′.2
A South pole	42 44.4	41 15.3
Mean	42 58.1	42 44.3

Resulting dip, August 17, 42° 51′.2.

STATION No. III. COCOLAPAM NEAR ORIZABA.

	Needle No. 1.	Needle No. 2.
A. North pole	43° 22′.5	44° 18′.3
A. South pole	42 9.1	41 36.1
Mean	42 45.8	42 57.2

Resulting dip, August 26, 42° 51′.5.

STATION No. IV. SAN ANDRES CHALCHECOMULA.

	Needle No. 1.
A. North pole	44° 7′.7
A. South pole	41 8.7
Resulting dip, September 18	42 38.2

STATION No. V. MIRADOR.

	Needle No. 1.	Needle No. 2.
A. North pole	43° 43′.7	45° 3′.0
A. South pole	43 55.0	42 37.3
Mean	43 49.4	43 50.2

Resulting dip, October 10 and 11, 43° 49′.8.

STATION No. VI. CITY OF MEXICO.

	Needle No. 1.	Needle No. 2.
A. North pole	41° 35′.1	41° 24′.7
A. South pole	41 16.0	41 29.3
Mean	41 25 6	41 27.0

Resulting dip, December 17, 41° 26′.3.

STATION No. VIII. RANCHO TLAMACAS.

	Needle No. 1.	Needle No. 2.
A. North pole	42° 30′.3	42° 37′.8
A. South pole	42 26.4	42 42.6
Mean	42 28.4	42 40.2

Resulting dip, January 25, 42° 34.3.

RECAPITULATION OF RESULTS OF THE MAGNETICAL OBSERVATIONS.

No. of station.	Name.	Lat. N.	Long. W. of Greenwich.	Date.	Declination east.	Dip N.	Horizontal intensity.	Height above the sea.
								English feet.
I.	Vera Cruz	19° 12′	96° 9′	1856, Aug. 7–8	8° 17′	43° 58′	7.533	14
II.	Potrero	18 56	96 48	" " 16–17	8 39	42 51	7.574	1,988
III.	Cocolapam	18 53	97 4	" " 26–27	8 28	42 51	7.579	4,042
IV.	San Andres	18 59	97 15	" Sept. 17–18	8 13	42 38	7.589	7,800
V.	Mirador	19 13	96 37	" Oct. 10–11	8 2	43 50	7 522	2,400
VI.	City of Mexico	19 26	99 5	" Dec. 10–17	8 46	41 26	7 576	7,550
VII.	Chalco	19 18	98 51	1857, Jan. 6	9 3	43 12	7.540	7,480
VIII.	Tlamacas	19 3	98 39	" " 25	8 28	42 34	7.571	12,750

PART II.

NOTES

ON THE

VOLCANO POPOCATEPETL AND ITS VICINITY.

GENERAL REMARKS.

WITHIN the last three years several ascensions have been accomplished of the volcano Popocatepetl, and also two or three attempts made to reach the highest point of the Ixtaccihuatl. Mr. Walker Fearn, Secretary U. S. Legation in Mexico, and Dr. Crawford, U. S. A., who ascended these mountains in January, 1857, have published such excellent general descriptions of them, in different journals, that little is to be added on this subject. I confine myself therefore to a geographical and geological description,[1] and give a few notes in regard to the difficulties of the ascent and the necessary precautions to be observed in the undertaking, which may perhaps prove of use to travellers, hereafter attempting the exploration of these or similar mountains.

The Popocatepetl and Ixtaccihuatl are the highest peaks of a mountain ridge, having a mean breadth of about fifteen and a length of forty English miles; running from Lat. 18° 55′ to Lat. 19° 30′ N., in a direction nearly N. 10° W., at a distance of thirty-five to fifty miles east of the city of Mexico. The average height of the ridge is about 5000 feet above the plateau from which it rises, or 13,000 English feet above the level of the sea; the Popocatepetl forms its southern termination, and to the south of it the plateau also falls off—at many places abruptly—several thousand feet.

To the east of this ridge is the alluvial plain of Amecameca, 8200 feet above the sea, and separated from the valley of Mexico, which is 700 feet lower, only by a low ridge of volcanic origin—containing several cones with extinct craters—the height of which above the plain does not exceed a thousand feet; the waters from the west side of this ridge run into the lakes, which occupy the centre of the valley of Mexico.

On the east side the mountains are bounded by the valley of Puebla, which is about 7500 feet above the level of the sea; and the waters from this and the south side run into the "Rio Mescal," a river which passes through the city of Puebla and empties into the Pacific Ocean. To the north the ridge decreases gradually in height until it loses itself in the plains of Apam (los llanos de Apam),

[1] I take this opportunity to express my obligations to Prof. Monross, who kindly furnished me with some valuable notes on the geology of Popocatepetl, after we ascended the volcano together in June, 1857. Free use of these notes has been made in the present description.

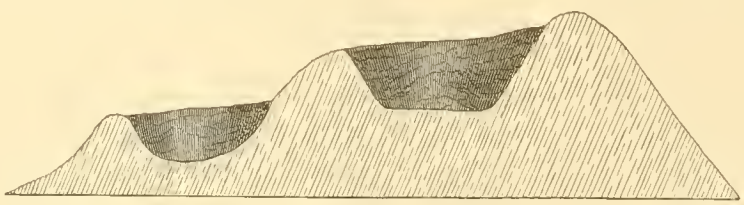
which have nearly the same elevation above the level of the sea as the plain of Amecameca.

The most convenient starting point for ascending the mountains is the town of Amecameca, situated in the plain which takes its name from it, at the eastern base of a hill, called "Sacremonte." A chapel stands upon the summit and another on the eastern slope of this hill, which is about 400 feet above the plain. At the town seven or eight Indians should be engaged as guides and to man the capstan, by which, with a rope attached, the traveller is lowered down into the crater. The first spurs of the ridge are reached a mile east of the town. They rise very gently for a considerable distance, but gradually become steeper and steeper. Where they are intersected by small ravines or gullies, washed out by the torrents, there appear just beneath the surface alternate layers of yellow pumice and black volcanic sand, in which boulders of feldspathic and porphyritic lava are entirely or partially imbedded. The surface in the upper regions is covered with a long wiry grass, and studded with pine-trees. Boulders of various sizes and shapes are scattered over it in all directions.

No lava streams appear to have run down on the west side of the mountain, and the absence of such streams is explained by the fact, that the western wall of the crater is nearly 600 feet higher than the eastern rim. A similar elevation of the western or southwestern wall above the opposite, as far as I have noticed, exists in all recent Mexican craters. It is particularly well defined on the peak of Orizaba, where even from Vera Cruz a horizontal black line is seen just below the highest point, strongly contrasting with the snow around it: this line is the western wall of the crater.

The volcano of the Colima, and the volcano of Toluca also, have their highest points at the west sides of their craters. The same peculiarity marks the outline of a volcano of very extraordinary form, situated in the valley of Mexico, about twelve miles S. E. by E. from the city, near the village of Ayotla, and called the volcano of San Isidro: it has two distinct craters; the eastern is much lower than the western, and divided from it by a wall of very compact lava; the highest point—about 1500 feet above the level of the lakes—is W. S. W. from the western crater. The bottoms of the craters of this volcano are at present cornfields.

Fig. 1.



VOLCANO OF SAN ISIDRO, SEEN FROM N. N. W.

I might add many more instances, in which I have observed the western walls of the craters of Mexican volcanoes to be considerably higher than their eastern edges, but it will be sufficient to state that, in no case, have I seen a volcanic cone whose crater is of recent formation, the east side of which was higher than the

west side, nor do I recollect to have seen one, the east and west sides of which had the same elevation. But this singular law holds good not alone for volcanic cones.

On the plain of Perote, near a silver mine called "La Preciosa," there are three small lakes of nearly circular form, which are evidently of volcanic origin. The one nearest to the mine is the largest; its longest diameter runs from N. 31° E. to S. 31° W., and measures nearly 2000 yards. The surface of the water is about twenty-five feet lower than that of the surrounding plain, and the banks are perpendicular. The Director of the mine informed me that he had attempted to sound the lake, but found no bottom at 250 fathoms. The water is brackish, and its temperature was 69°.2, while the temperature of the air in shade was 65°.0 (noon, Sept. 20, 1856). The two other lakes are of similar form, but somewhat smaller. No one of them has an outlet, nor do any streams empty into them, as it does not rain more than four or five times a year in their vicinity. Nevertheless the water is perfectly clear, and of the dark color of sea-water in deep soundings. The shores of these three lakes on the east side, are not elevated above the general level of the surrounding plain, but on the west side they rise into hills (the one at the larger lake being about 160 feet high) sloping gently towards the plain, but falling off abruptly towards the lake, presenting the appearance of an excavation, of which the material was thrown up on its western banks. The surface of the hill consists of coarse sand. The trade-winds, which are prevalent in these regions and blow from E. N. E., may, perhaps, furnish an explanation of this peculiar elevation of the western walls of the more recent craters above their eastern rims.

As stated before, no lava is seen at the surface of Popocatepetl on its northern and eastern slopes; but at rare intervals, in the deeper ravines (barrancas), solid ledges of very compact lava are to be found. Passing around the volcano from the north through east to the south, the first lava-stream on the surface is met with on the eastern slope of the cone, commencing a little below the limit of perpetual snow; this stream has probably its origin at or near the present crater, but the upper part of it is covered by volcanic sand and snow. It is soon joined by another and larger stream, the outlines of which are distinctly defined above the snow-mantle of the cone up to the edge of the crater, where it forms a point projecting a little above the general profile of the mountain, when seen from the north. The altitude of this point was determined trigonometrically, and in the following observations it is distinguished by the name of the "eastern peak," from the highest or "western peak." The stream is called "el espinazo del diablo" (the devil's backbone), and extends about three miles down, losing itself near the eastern base of the mountain.

On the southeastern and southern slopes large lava-streams extend from the crater down to the edge of the plateau (from which the volcano rises ten thousand feet vertically), and cover a space of many square miles. The surface of the lower and nearly horizontal parts of these lava-fields (pedregals) is studded with boulders of all dimensions, mostly approaching to a globular form, or to segments of globes, and containing much iron and nickel. The lava of these fields is sometimes of a red (cinnabar) or brownish, but more generally of a dark gray,

color, and not rarely perfectly black, sometimes with a glazed surface not unlike obsidian.

Within six or seven miles from the crater, the layers of volcanic sand and pumice become very regular, as seen at all places where they are exposed on the sides of the ravines and gullies. The stratum immediately beneath the surface is a layer of coarse, black sand, three feet thick, then succeeds a layer of reddish-yellow pumice, only one quarter of this thickness, then again a layer of sand, and so on alternately; showing that at the last eruptions a shower of pumice first issued, which covered the ground from three inches to a foot in thickness, to a distance of six or seven miles from the crater; this was followed by a shower of gray or black sand, the deposit from which reached a thickness of from three to six feet. An interesting proof that the last eruption was at no very remote date is afforded by the trunk of a pine-tree, which was found, when I last ascended the volcano, in company with Prof. Monross, in June, 1857, imbedded in the last layer of pumice, below the uppermost strata of volcanic sand, more than three feet below the surface. The outside or sapwood of the tree had decayed, but the interior wood being impregnated with turpentine was still perfectly fresh and well preserved. Certainly not many centuries can have passed since this tree was buried.

About three miles from the point where the trunk of the pine-tree was found, we reached the highest human residence in this part of the world. It consists of a few Indian huts and a log house, in front of which are the ovens for purifying the sulphur which is brought down from the crater. The place is called "Rancho Tlamacas," and has an elevation of nearly 12,800 English feet above the level of the sea. Here the traveller can remain for the night, and, leaving early the next morning, may reach the edge of the crater about noon without much exertion.

About half a mile to the west of this "rancho" we crossed a ridge of rock, which runs from the "Pico del fraile," situated on the west side of the highest peak, to the Ixtaccihuatl, rising at several points into irregular peaks. This ridge is not a stream of lava from the present crater, but a dike of ancient volcanic rock (gray stone), upheaved by the later action of the volcano. About 400 feet above the rancho, or at nearly 13,200 feet of absolute height, the last stunted pine-trees are seen, and this may be assumed as the limit of vegetation; some wiry grass, only, growing in bunches, is found for a short distance higher up. During the summer months, or, more properly, the rainy season, the snow often extends on the north and west side of the volcano down to this limit, or even lower, as we experienced during the latter part of June, having been for three days enveloped in a dense fall of snow, at the Rancho Tlamacas, which covered the ground nearly twelve inches deep, although much of it melted immediately. This snow-storm extended at least a thousand feet further down, terminating at a height of from 11,700 to 11,800 feet.

The limit of perpetual snow is about 1000 feet higher than the limit of vegetation, or, on the north and northwest side of the mountain, 14,200 feet. On the south and southeast side it is much higher, and from below there can be traced black lines, which are in reality lava-streams, up to the edge of the crater (17,200

feet). The snow extends much lower down during the summer (from June to September) than during the winter months (from October until May). This is caused by the supply of moisture from the clouds, in which the mountain tops are wrapt almost constantly during the rainy (or summer) season. Snow falls the greater part of this time, and though the sun is very powerful, it rarely breaks through the clouds. The snow, melted by the heat, is replaced almost immediately by a fresh fall, whilst in winter, when the sky is generally clear, the accumulated snow is melted to a great extent by the direct rays of the sun.

Before reaching the limit of perpetual snow, there appears a layer of transparent ice beneath the upper strata of black sand. I observed the first traces of this ice at a height of 14,000 feet. I could not ascertain its average thickness, although this is evidently considerable. The sand lies from two to four feet deep above it. In an attempt to ascend the peak of Orizaba, in September, 1856, I also noticed, near the limit of perpetual snow, a layer of similar ice beneath the first stratum of sand. This seems to prove that, at the time when the last eruption occurred, the snow extended as low or lower down than the ice does at present. The ejected sand, still warm when it reached the ground, would melt the surface of the snow, and the water, thus produced, penetrating into the lower layers of snow, would freeze again, changing the strata with which it is mixed into a kind of glacier ice. This ice, protected from the solar heat by the covering of sand, is not liable to thaw, and that part of the rain or melted snow, which filters every year through the layer of sand, freezes as soon as it comes in contact with the stratum of ice, thus increasing its bulk; and, as at this height the mean temperature of the year is below the freezing point, it is not probable that it would ever melt again.

A deep gully or ravine, the head of which is about 16,000 feet above the level of the sea, issues from between the highest or western peak and the "Pico del fraile." It runs for some distance in a N. N. E. direction, turning afterwards more to the east. This gully exposes the strata as they were deposited just on the foot of the volcanic cone by many successive eruptions. The lower beds are of a light brownish-red or of a yellowish-white color, and consist of pumice and scoriæ, while the last six layers are alternately pumice and black sand. From this it would appear that the vast mantle of black sand, which covers the cone as well as the slopes of the mountain for many miles, is the product of the last efforts of the expiring volcano.[1]

After leaving the "Rancho Tlamacas" it is still possible to ride for a considerable distance on horseback, and travellers generally dismount and leave their horses only a few hundred yards below the limit of perpetual snow. The animals can, of course, only make slow progress in ascending the steep slopes of the mountain, as they are obliged to walk in deep sand, affording no secure footing, and often slide back as much as they advance; but the traveller, in riding, saves his strength meanwhile for the toil of ascending the last 3500 feet.

It is always best to get upon the snow as soon as possible after leaving the horses, because this affords a much better footing than the loose sand. The eyes should

[1] This passage was copied from one of Prof. Monross' notes.

now be protected by colored glasses or by a green veil. In consequence of neglecting this precaution when I attempted to reach the crater of the peak of Orizaba in September, 1856, I suffered severely for several days with snow blindness. It is well to send four or five of the Indians ahead that they may tread steps into the snow, or where the surface is hard, cut them in with a hatchet. By means of these steps the ascent is rendered at once safe, easy and short, as, the average slope being about 30°, about one foot is gained in height for every two feet of distance. I found ice spurs and long iron-pointed sticks or boat-hooks entirely unnecessary, only encumbering the traveller, and followed, in my second and third ascent of this volcano, the example of the Indians, who use nothing but a common rude walking-stick, notwithstanding that each one carries a load of from twenty-five to fifty pounds on his back. I did not pass or see a single dangerous spot, and consider myself very fortunate in not encountering any of those places, where "one slip of the foot or a single false step would precipitate the wanderer into the fearful abyss which yawns beneath him," such as some travellers, who ascended the mountain a short time before I did, found on their road, although it must have coincided nearly with the one I took. On the peak of Orizaba, however, and also on the Ixtaccihuatl, I have seen crevices in the snow which might well prove fatal to the careless mountaineer.

A very unpleasant sensation is experienced in approaching the summit of a high mountain, in consequence of the difficulty of breathing during the ascent. It is not felt as much while walking as during the intervals of rest, which become necessary every fifteen or twenty minutes, and is so much like choking, that the traveller is sometimes impelled to tear the veil from his face and to throw off his neckcloth to obtain air.

But, although I have been five times on heights exceeding that of Mont Blanc—between 16,400 and 17,400 English feet, and generally accompanied by eight or more persons, I have never seen an instance of blood rushing from the nose, mouth and ears, as observed by many travellers; and my opinion is, that whenever it occurs, the cause of it is more the exertion than the rarefied air. Neither have I ever experienced the painful sensation in the limbs, often mentioned, and ascribed to the relaxation of atmospheric pressure upon the joints.

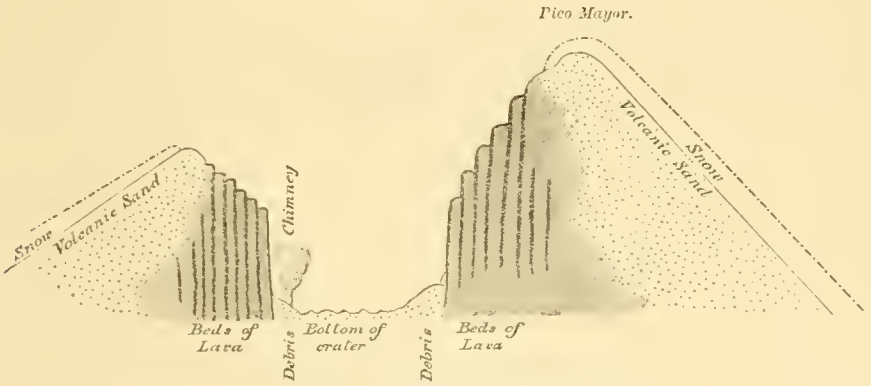
The slope of the snow-covered part of the volcano on its east and north side is very uniform, and the surface is only slightly undulating, so that it approaches the form of a regular cone. When half way up, the sulphurous odor with which the air above is impregnated is sensibly perceived.

On reaching the crater the snow-mantle breaks off abruptly, showing that here (on the north side) its thickness does not exceed five, at many places scarcely three, feet. The sides of the crater at the place where it is entered, fall off with an inclination of about 40° for the first hundred feet. The steep slopes are covered with black volcanic sand of the same nature as that which covers the surface at the foot of the cone. Above the sand project huge rocks of a very compact, dark gray or black lava, most of which present a rounded surface, except where they have been split after their formation. Thirty-two feet (perpendicularly) below the point where the crater is entered, is an overhanging rock, against which the Indians, who carry

the sulphur, have placed a few boards. This place is called by them "la cueva" (the cave), and it affords a little protection, at least, against the piercing winds and the snow. Here I slept two nights, in January and February, 1857, on one of these the thermometer going down as low as —11°.8 C. (February 9, at 4 o'clock A. M.).

About thirty feet below "la cueva" is placed a rudely-constructed capstan of wood, by means of which the sulphur is raised. It is also used in lowering persons down the vertical part of the crater, which has here the least height, but which still amounts to about 250 feet. From this point there is a magnificent view of the crater, the southern and western walls of which indicate, by their shelved or terraced form, that the lava must have accumulated in successive thick and irregular beds.

FIG. 2.



SECTION OF CRATER FROM EAST TO WEST.

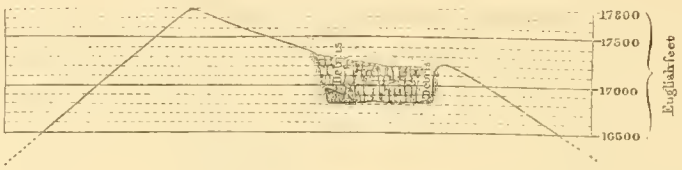
The accompanying sections of the crater and the upper part of the cone may, perhaps, serve to illustrate its general structure. The nucleus of the cone is composed of compact lava, which, at least in the upper parts, is arranged in nearly vertical beds. This has little or nothing of the light, spongy or scoriaceous character of that seen in some volcanoes; as, for instance, in the modern crater of Jorullo (according to Prof. Monross), but is hard and very heavy, mostly of a dark-red, or bluish-black color. These beds nowhere show a basaltic or columnar structure. The nucleus of the cone is covered by a thick mantle of sand, scoria, and pumice, where it is not too precipitous.

In descending into the crater, the traveller is usually preceded by an Indian, and there is some danger of being hurt by the stones which are constantly falling from above him. The action of the frost is doubtless a principal agent in detaching these stones. The sun shining on the snow which covers the edge of the crater, and the shelves or narrow terraces, melts a part of it, the water penetrates into the minute crevices of the rocks, where it freezes again, and, expanding while it changes into ice, has an effect similar to that of gunpowder.

One of the guides, who had been many times in the crater, asserted that the bottom of it rises six feet annually by the accumulation of the detached stones. This is certainly an exaggeration; nevertheless, the amount of rise is considerable, since at least ten stones fall per hour, of more than two feet diameter, or certainly more than 2000 cubic feet in a day (probably double this quantity). If now we

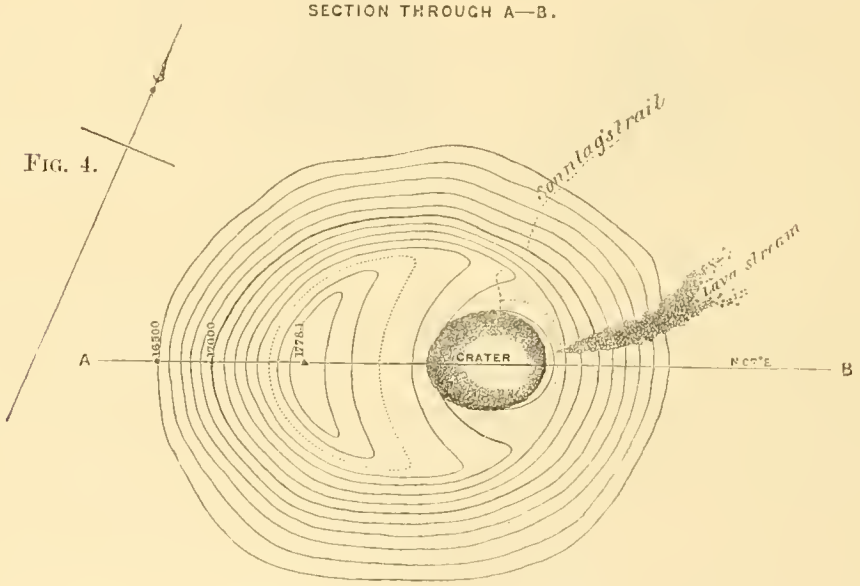
assume the diameter of the bottom of the crater, including the *debris* on which many of the falling stones remain—(the horizontal part of the bottom has a diameter of only 750 feet)—to be 1200 feet, the surface will be 1,130,000 square feet, and the quantity of stones falling annually at the rate of 2000 cubic feet for a day, amounts to 730,000 cubic feet, so that, if the bottom was covered uniformly, it would rise about 0.65 of a foot in a year. But as the stones do not reach the middle, the sides or *debris* must increase considerably more rapidly. This would indicate that the crater must fill up, and the height of the cone sensibly decrease within a thousand years if the volcano should remain inactive. The diminution of depth will, however, be less and less every year, in proportion as the upper part of the crater expands and the depth diminishes. (Figs. 3 and 4 exhibit a section and plan of the summit.)

Fig. 3.



SECTION THROUGH A—B.

Fig. 4.



SUMMIT AND CRATER OF POPOCATEPETL

Scale — 1:20000.

Besides stones of smaller sizes a large quantity of sand is continually falling which tends to fill up the empty spaces left between the larger stones. It is set in motion by the wind, which generally blows very fresh on the summit, and by falling stones. Very little is required to disturb the sand, as it is deposited on the steep walls of the crater.

After being detached from the rope, and while continuing the descent of the talus, we were several times compelled to take refuge from the falling stones behind a large boulder or a vertical wall. In January and February the *debris* was nearly clear of snow, but in June we found it covered with a thick layer, the surface of which was so hard that we were obliged to cut steps in it with a

hatchet by which to descend. Our guide, whilst engaged in this work, at one time lost his footing, and slid down about thirty paces before he succeeded in stopping himself.

The horizontal part of the bottom of the crater is covered with snow, above the surface of which rise only a few large boulders. In February, I noticed on the northeast side, at a place where the snow was wanting, some water of a bluish-white color and a sour taste. In June this water had disappeared, and the surface was covered uniformly with snow, except in the vicinity of the chimneys, called by the guides "respiradores." These exhibit the last, feeble evidence of the former activity of the volcano, but its main throat has been so effectually choked up by the rubbish, which has fallen into it, that at the lowest and central part of the bottom no vapors issue. The present vents are a little way up the slope, and from the two largest of these, one on the east, the other on the south side, rise volumes of vapor which extend to the edge of the crater, and sometimes in clear, calm weather are seen above it. The noise of these jets may be heard at the top of the crater, where it sounds much like the roaring of the wind, which may have given rise to the belief common among the Indians, that a passage exists between the crater and the surface of the cone near the top of "Pico del fraile," through which the wind whistles. At the "respiradores" the steam issues from the crevices between the stones, which, as well as the sand in their vicinity, are covered with crystalline sulphur.

The principal vent on the south side is about thirty feet in diameter, and filled up with stones of all sizes, which are entirely encrusted with sulphur, and decomposed by its action to such a degree, that small pieces of them may be crumbled to powder between the fingers. The large vent to the east does not cover so much ground, but the steam issues under a higher pressure; stones of eight or nine inches in diameter, when cast upon one of the crevices, through which the vapor escapes, are thrown back with such force as to fall to the ground several feet from the opening. When we removed one of the larger stones from the vent, by the aid of a long pole, sand, small stones, and sulphur, which had been covered by it, were thrown up more than ten feet into the air. We tried also to measure the temperature of the vapor issuing from the "respiradores," but the thermometer being graduated only to 160° F., burst from the heat, which exceeded this temperature.

There is not much sulphur seen in the crater except near the vents, where it is precipitated from the vapor and deposited on the rocks and the ground. This may be accounted for by the fact that the falling stones and the *debris*, which is constantly renewing the surface of the bottom of the crater, must certainly cover any old beds of sulphur which may exist. The vapor which escapes consists of steam, highly charged with sulphur in the form of sulphuretted hydrogen and of free sulphur in vapor. Very little sulphurous acid issues, although this acid as well as sulphuric is found in the air of the crater, as is proved by the sour taste of the icicles and by incrustations of sulphate of lime on some of the rocks. As already mentioned, the air not only in the crater, but outside half way down the cone, is impregnated with sulphur, proving that a very large quantity of it is discharged.

At the time of our explorations, in June, there was a cloud resting on the top

of the mountain while we were at the bottom of the crater. The combined effect of this and the vapor on the light was very interesting. While standing near the chimneys, we noticed that every light object was tinged with a reddish color; patches of snow appeared of a pink hue; a white pocket handkerchief was of a light rose-color, and the gold of a watch-case resembled copper.

The last part of the ascent of the volcano, from the snow line to the crater, is generally accomplished in four hours and a half; the vertical height of this part of the cone is 3300 feet, and therefore only a little over twelve feet in height is gained in one minute. The same distance is descended in an hour or an hour and a half. The horses were left at an elevation of 14,000 feet, and the edge of the crater, where we descended into it, is 17,300 feet above the sea.

The lower part of the Ixtaccihuatl has a more cheerful appearance than the corresponding parts of the Popocatepetl. The soil, less covered with volcanic sand, is more favorable to vegetation; while nothing but pine-trees are seen on the slopes of the "smoking mountain" (the meaning of the Aztec word "Popocatepetl"), the spurs of the Ixtaccihuatl (Aztec for "white woman") are covered to a considerable height with a variety of flowers and trees of luxuriant foliage. Nevertheless, this mountain is also entirely of volcanic formation, and its upper parts are nearly as much covered with volcanic sand as the Popocatepetl, which probably has been thrown thus far by the latter volcano, since the entire ridge which connects the two mountains is covered with the same material, and their distance does not exceed ten miles. Many persons are of opinion that there has formerly been a crater between the highest and the northern peak of the Ixtaccihuatl, the walls of which are now broken down and have filled up the cavity. The appearance of the northern side favors this hypothesis. I regret much that I had not an opportunity of approaching the north and east sides of this mountain near enough to decide whether the beds of dark-colored rock seen there are streams of lava or upheaved ancient volcanic rock. The south and west sides, which I explored, are of graystone formation. Passing a perpendicular wall of this material a little below the line of perpetual snow, I noticed, near some crevices in the rock, yellow spots, having exactly the appearance of crystalline sulphur; the spots were, however, so high up the wall that I could not reach them. If the Ixtaccihuatl has ever been an active volcano, a much longer time must certainly have elapsed since its last eruption than since that of the Popocatepetl.

The ascent of the Ixtaccihuatl offers much greater difficulties than that of "Popocatepetl," on account of its steep sides and deep fissures in the snow, which are sometimes concealed by a thin crust, and in that case they become very dangerous to the explorer. I doubt, indeed, whether the highest point of this mountain has ever been reached, although I am convinced that it might be attained by parties properly prepared. The last point which I reached (in February, 1857) was 600 feet vertically below the highest peak. To this I ascended without much exertion, following for the greater part of the way a ridge of boulders on the north side of the deep ravine, which, starting near the top, on the west side of the mountain, extends in a westerly direction and loses itself in the plain of Amecameca.

The enormous size of the boulders on the western slope of this mountain must always attract the attention of the traveller. Many of the blocks are from twenty-five to thirty feet in diameter, not rounded, like those on Popocatepetl, but having plane faces and angular edges. They are sometimes isolated, but more generally in ridges running down the slopes of the mountain, and commencing often far above the line of perpetual snow.

HYPSOMETRICAL DETERMINATIONS.

BAROMETRICAL AND TRIGONOMETRICAL MEASUREMENTS OF HEIGHTS.

Determinations of the heights, derived from one or even from several barometrical observations, are liable to a considerable error, if they are continued only for a few hours at the upper station, and if the lower station is very distant; but for a sojourn of several days at a height of nearly 18,000 English feet above the sea—though within the tropics—preparations on an extensive scale become so necessary, that I could not think of adopting this plan, although it would have been very interesting in many respects.

I concluded, therefore, to make a series of barometrical observations extending over several days, at the highest convenient point; to determine the elevations of the different peaks above this point trigonometrically; and to observe barometers at the highest points to which I might ascend, so that the two measurements would check each other.

For the lower station I took the city of Mexico as the nearest place of known altitude, at which I could obtain corresponding observations. The most convenient places I found for trigonometrical stations were; on the base of the cone of the Popocatepetl; the "Rancho Tlamacas," which is 5000 feet below the highest peak, and a little more than 5000 feet above the city of Mexico; and on the base of the Ixtaccihuatl, a small plain, 11,600 English feet above the sea. At the two latter stations a French syphon-barometer was employed, and before and afterwards compared with two barometers, which were observed simultaneously in Mexico.

This barometer could not be used at much greater heights than those of the trigonometrical stations, and several other French and English syphon-barometers which were at that time at my disposal were also rendered useless at these great elevations: the mercury in the long arm retreating into the brass tube, or below the limit of the scale; and in the short arm rising above the divisions. Besides this, it was very difficult to transport long glass tubes, filled with mercury, over such rough ground as the upper part of these mountains presents. I took, therefore, two barometer tubes of large diameter, and cut them off, one to the length of 500 and the other to 440 millimetres. The open end was then heated under the blow-pipe, and the aperture reduced to so small a size that it could be easily closed air-tight by the point of the finger; to each of the tubes a scale of dry cedar-wood was attached, on which minute divisions might be read without difficulty,

and which extended over the entire length of the tube. In addition to the empty tubes and the scales, I carried with me two small wooden vessels or cisterns each of two inches diameter, and two inches deep, together with a quantity of mercury. On arriving at the point to be measured, the two cisterns were filled to the depth of an inch and a half, and the tubes entirely, with pure mercury; care being taken to expel the small bubbles of air by slight shaking. The aperture of each tube was then closed with the finger, and the whole inverted with the open end below the surface of the mercury in the cistern. After the mercury had settled in the tube, the scale was read at the top, and also at the level of the quicksilver in the cistern. The difference of these readings gave the length of the mercurial column. This should be reduced for temperature, on account of the expansion of mercury and the wood, but the correction, arising from the latter, was neglected, being very small. At the trigonometrical station on the Ixtaccihuatl, at a temperature of +9°.6 C., the longer of the tubes was found to agree perfectly with the syphon-barometer. In Tlamacas the difference scarcely exceeded $0^{mm}.2$, showing that the result, obtained by this simple barometer, has claims to a considerable degree of accuracy.

The instrument used for measuring the vertical angles, and for the triangulation, was made by Ertel, of Munich. It had a repeating circle, which could be mounted vertically for measuring altitudes, or horizontally for azimuths; and by means of four verniers it read to 10″. When the circle was in a horizontal position it carried a telescope with broken axis; for observations of altitudes an extra telescope had to be attached as well as a level, and so many adjustments were required, that much time was consumed in mounting it vertically. The instrument belonged to the Mining School, in Mexico, and was kindly lent to me by that institution. It had been treated rather roughly before, and, owing to this as well as to its complicated construction, it required great care and much patience in using it. The readings when the telescope had been moved from the left to the right, or from above downwards, were always different from the readings when it had been moved from the right to the left, or from below upwards. This difference, sometimes amounting to more than two minutes, was the principal cause of the want of agreement among the single measurements, and I have on this account given them, in full detail. The observations were, however, so arranged, that all constant errors, which might arise from torsion, or from tension, and collimation, were eliminated.

The standard used in measuring the base-line was a brass scale, the length of which was determined in Mexico, and found to be 622 millimetres, at a temperature of +15° C. With the aid of this standard the length of a rod used in measuring the base-line was accurately determined. The direction of the line was carefully marked by a thin rope, stretched, and at several places supported, so as to form very nearly a straight line. Besides the wooden rod, a steel-tape of ten metres length was used, and the two measurements of the base, obtained with these instruments, agreed in both cases within 0.06 of a metre.

Corresponding barometrical observations were made in Mexico by Mr. Diaz-Covarrubias, at a temporary observatory near the gate "San Lazaro," and by Mr.

Poole, at the Hotel Iturbide. The barometer of Mr. Diaz-Covarrubias stood $0^{mm}.20$ lower than the instrument I used, and a correction for this has been taken into account in the computation of the observations. Mr. Poole's barometer and my own agreed perfectly. I give his observations, which he kindly communicated to me, in the following pages, together with my own. The observations of Mr. Diaz-Covarrubias I am not able to give at present.

The direction of the wind is not given, as it is difficult to determine its true course with any accuracy among the mountains, where it follows the direction of the valleys and ravines. Generally the weather is nearly calm in the mornings, and at two o'clock P. M. a fresh easterly wind sets in, which continues to blow until seven or eight o'clock P. M., when it becomes calm again. The atmosphere during the observations was mostly clear, and is always nearly so from November till May, except when northerly winds blow.

OBSERVATIONS OF BAROMETER AND TEMPERATURE.

City of Mexico.—Barometer 55.5 English feet above the ground. Observer W. Poole.

1857.	Hour.	Temperature of air.	Barometer.	Attached thermometer.	Reduction.	Barometer at freezing point.	
Jan. 23	4h.1 P.M.	—	587mm.25	17°.6 C.	—1mm.67	585mm.58	
23	7.0 P.M.	—	587.65	14.7	1.40	6.25	
25	2.0 P.M.	—	588.65	12.2	1.16	7.49	
30	9.0 A.M.	12°.0 C.	587.10	12.0	1 13	5.97	
30	10.0 A.M.	14.0	587 10	14.0	1.32	5.78	
30	12.0 M.	17.0	586.07	17.0	1.60	4.47	
30	2.0 P.M.	18.0	585.10	18.0	1.70	3.40	
30	3.5 P.M.	16.2	584 70	16.2	1.53	3.17	
30	4.0 P.M.	16.1	584.66	16.1	1.52	3.14	
30	6.0 P.M.	14.8	585.15	14.8	1.41	3.74	
30	8.7 P.M.	10.5	587.15	16.5	—1.57	5 58	
30	10.0 P.M.	9.0	586.66	13.5	1.28	5.38	
30	11.0 P.M.	8.0	586.57	13.7	1.30	5 27	
31	8.0 A.M.	7.1	587.59	7.2	0.69	6.90	
31	9.0 A.M.	10.6	588.22	10.8	1.03	7.19	
31	11.5 A.M.	14.8	588.00	14.8	1.41	6.59	
31	12.0 M.	16.2	587.73	16.2	1.54	6.19	
31	1.5 P.M.	17.3	587.00	17.3	1.63	5.37	
31	3.5 P.M.	17.3	586.54	17.3	1.64	4.90	
Feb. 1	9.0 A.M.	8.5	588.31	8.2	0.78	7.53	
1	0.5 P.M.	17.0	588.22	17.0	—1.61	6.61	
1	3.0 P.M.	16.8	587.02	16.8	1.58	5.44	
4	5.5 P.M.	—	588.45	15.3	1.46	6.99	
5	8.8 A.M.	10.0	588.35	13.6	1.29	7.06	
5	10.2 A.M.	14.0	588.95	14.0	1.33	7.62	
5	11.5 A.M.	15.5	588.40	15.0	1.43	6.97	
5	5.6 P.M.	13.5	586.30	15.0	1.42	4.88	
6	5 9 A.M.	—	583.35	15.5	1.46	1.89	
7	10.0 A.M.	13.7	584.75	13.7	1.29	3.46	
7	5.2 P.M.	—	584.70	16.4	1.55	3.15	
7	6.7 P.M.	—	584.35	14.0	—1.32	3.03	
8	9.0 A.M.	8.0	586.25	11.7	1.10	5.15	
8	0.2 P.M.	15.2	585.80	15.2	1.44	4.36	
8	2.0 P.M.	17.0	585.45	19.0	1.79	3.66	
8	3.8 P.M.	15.1	585.70	19.6	1.85	3.85	
8	7.8 P.M.	11.0	586.75	10.6	1.00	5.75	
9	8.0 A.M.	6.1	587.65	6.1	0.58	7.07	
9	9.0 A.M.	8.8	587.85	8.8	0 84	7.01	
9	10.0 A.M.	11.1	588.10	11.1	1.06	7.04	
9	11.0 A.M.	12.8	588.05	12.8	1.22	6.83	
9	12.0 M.	15 3	587.90	15.3	—1.46	6.44	
9	12.7 P.M.	16.3	587.80	16.3	1.55	6.25	
9	3.3 P.M.	17.9	587.55	17.9	1.70	5.85	
9	5.2 P.M.	17.0	587.85	17.0	1.61	6.24	
9	6.0 P.M.	15.6	588.10	15.6	1.48	6.62	
9	7.0 P.M.	13.8	588.25	13.8	1.31	6.94	
9	11.0 P.M.	6.8	588.10	6.8	0.65	7.45	
11	1.0 P.M.	14.3	589.94	14.3	1.36	8.58	
11	2.0 P.M.	16 3	589.39	16.3	1.55	7.84	
11	3.0 P.M.	17.1	588.85	17.1	1.63	7.22	
11	4.0 P.M.	17.1	588.50	17.1	—1.63	586.87	
11	6.0 P.M.	13.5	591.42	13.7	1.30	90 02	
11	7.0 P.M.	—	590.43	13.7	1.30	89.13	
12	10.0 A.M.	12.0	592.58	12.7	1.22	91.36	
12	11.0 A.M.	14.8	593 65	14.8	1.42	92.23	
12	12.0 M.	16.2	593.67	16.2	1.55	92.12	
12	1.0 P.M.	17.7	593.23	17.7	1.69	91.54	
12	2.0 P.M.	18.3	592.91	18.3	1.75	91.16	
12	3.0 P.M.	18.6	592.58	18.6	1.78	90.80	
12	4.0 P.M.	—	592.38	18.3	1.75	90.63	
12	5.0 P.M.	—	592.15	1.77	1.69	90.46	

Town of Amecameca, Public Square [Plaza].—Barometer 2 feet above the ground. Observer A. Sonntag.

1857.	Hour.	Temperature of air.	Barometer.	Attached thermometer.	Reduction.	Barometer at freezing point.	
Jan. 19	1h.8 P.M.	16°.3 C.	574mm.08	18°.5 C.	—1mm.72	572mm.36	
19	3.0 P.M.	14.4	73.61	16.3	1.51	2.10	
19	4.0 P.M.	13.0	73.41	15.0	1.39	2.02	
20	7.0 A.M.	8.0	74.02	9.9	0.92	3.10	
20	7.8 A.M.	9.0	73.76	9.0	0.83	2.93	
27	7.5 P.M.	6.0	73.70	13.0	1.21	2.49	
27	10.0 P.M.	2.0	73.93	11.0	1.02	2 91	
28	8.0 A.M.	5.0	73.96	11.3	1.05	2.91	
28	4.0 P.M.	11.5	73.93	12 2	1.13	2.80	
Sacre Monte, near Amecameca.—Barometer 2 feet above the roof of the upper chapel.							
Jan. 28	11.0 A.M.	15.4	566.42	15.4	—1.40	565.02	
28	0.30 P.M.	16.0	565.99	19.0	1.73	564.26	

Rancho Tlamacas.—The barometer 2 feet above the ground. Observer A. Sonntag.

1857.	Hour.	Temperature of air.	Barometer.	Attached thermometer.	Reduction.	Barometer at freezing point.	Place of observation.
Jan. 20	3h.5 P.M.	+ 8°.0 C.	485mm.39	+ 9°.1 C.	—0mm.71	484mm.68	Indian huts.
20	4.5 P.M.	+ 5.9	484.50	+ 5.9	—0.46	84 04	"
20	5.5 P.M.	+ 1.4	484.32	+ 1.4	—0.11	84.21	"
20	6.5 P.M.	— 0.3	484.73	— 0.3	+0.02	84.75	"
20	7.5 P.M.	— 2 0	485.94	+10.7	—0.84	85.10	"
23	11.0 A.M.	+ 6.0	484.42	+ 8.2	—0.64	83.78	Station A.
23	12.0 M	+ 6.3	483.88	+ 6.4	—0.50.	83.38	"
23	5.0 P.M.	+ 3.2	482.80	+ 3 4	—0.26	82.54	"
23	7.5 P.M.	— 3.0	484.33	+ 8.6	—0.67	83.66	Indian huts.
24	8.5 A.M.	+ 1.5	485.18	+11.2	—0.88	84.30	"
24	10.0 A.M.	+ 4.0	484.71	+ 8.0	—0.63	84.08	Station A.
24	11.5 A.M.	+ 6.0	485.15	+10.0	—0.78	84.37	Indian huts.[1]
25	8.5 A.M.	+ 1 5	485.48	+11.5	—0.90	84.58	"
25	11.2 A.M.	+ 5.5	485.54	+11.7	—0.92	84.62	"
25	2.0 P.M.	+10.0	484.81	+10.5	—0.82	83.99	"
25	6.0 P.M.	— 3.5	484.94	+11.0	—0.86	84.08	"
26	6.0 A.M.	— 4.5	—	—	—	—	"
26	7.0 A.M.	— 2 0	485.40	+10.5	—0.82	84.58	"
26	0.7 P.M.	+10.0	485.64	+12.0	—0.94	84.70	"
26	5 2 P.M.	+ 1.2	485.69	+ 6.5	—0.51	85.18	"
27	9.0 A.M.	+10.2	486.37	+14.5	—1.14	85.23	"
Feb. 7	5.5 P.M.	+ 1.6	482.07	+ 2.0	—0.16	81.91	"
7	8.0 P.M.	— 1.0	483.05	+ 8.0	—0.63	82.42	"
7	9.0 P.M.	— 3.1	483.43	+ 6.0	—0.47	82.96	"
9	1.5 P.M.	+ 8.0	485.36	+ 8.0	—0.63	84.73	"
Cero Tlamacas.—The barometer on a level with the highest point.							
Jan. 24	1.0 P.M.	8.5	474.44	12.8	—0.98	473.46	
24	2.8 P.M.	9.0	473.95	10.5	—0.81	73.14	
24	3.5 P.M.	9.0	473.78	10.0	—0.77	73.01	
At Three Crosses on the road from Amecameca to Puebla.[2]—The barometer 2 feet above the ground.							
Jan. 27	12.0 M.	10.0	496.31	10.0	—0.80	495.51	
Point of Junction of the roads from Puebla and Tlamacas to Amecameca.—The barometer 2 feet above the level of the water, where the two creeks join.							
Jan. 27	0.5 P.M.	11.5	508.44	14.5	—1.19	507.25	

[1] Station A is 8 metres above the Indian huts.

[2] This is the highest point of the road, and at the same time the lowest point of the summit of the ridge, which connects the Popocatepetl and Ixtaccihuatl.

FOOT OF THE IXTACCIHUATL. Trigonometrical Station B.—The barometer 2 feet above the ground.

1857.	Hour.	Temperature of air.	Barometer.	Attached thermometer.	Reduction.	Barometer at freezing point.	
Feb. 3	2h.5 P.M.	9°.2 C.	506mm.16	9°.2 C.	—0mm.75	505mm.41	(1)
3	3.5 P.M.	8.4	505.88	10.0	0.81	5.07	(2)
4	8.0 A.M.	5.0	507.09	10.6	0.86	6.23	
4	9.0 A.M.	7.2	507.31	7.2	0.59	6.72	
4	10.0 A.M.	9.0	507.38	9.1	0.74	6.64	
4	11.0 A.M.	10.5	507.53	13.0	1.07	6.46	
4	1.0 P.M.	12.0	507.24	12.0	0.98	6.26	
4	3.0 P.M.	12.0	506.63	13.7	1.12	5 51	
4	5.0 P.M.	6.0	506.49	10.3	0.83	5.66	
4	6.0 P.M.	4.0	506.04	5.0	0.41	5.63	
IXTACCIHUATL, at the top of the cascade, where the Indian "Nieveros" cut ice to supply the City of Mexico.							
Feb. 3	5.5 P.M.	4.0	483.60	9.0	—0.70	482.90	
IXTACCIHUATL.—Rock projecting above the snow, about 600 feet (vertical) below the highest peak.							
Feb. 5	1.0 P.M.	1.0	422.5	+1.0	—0.07	422.43	Cistern bar. I.
5	1.0 P.M.	1.0	422.3	+1.0	0.07	22.23	" II.
5	1.1 P.M.	1.0	422.0	+1.0	0.07	21.93	" I.

POPOCATEPETL.

1857.	Hour.	Temperature of air.	Barometer.	Attached thermometer.	
Bottom of the crater.					
February 8	2.0 P.M.	+2°.0 C.	416.0	+7°.5 C.	Cistern barometer I.
8	2.1 P.M.	+2.0	416 0	+7.5	" " II.
Cave ("la cueva") in the crater.					
February 8	4.0 P.M.	—2.0 C.	406.5	—2.0	Cistern barometer I.
8	4.1 P.M.	—2.0	406.0	—2.0	" " II.

OBSERVATIONS OF TEMPERATURE ON THE POPOCATEPETL.—The observations were made at "la cueva," in the crater.

1857.	Hour.	Temperature.	1857.	Hour.	Temperature.
January 21	4h.0 P.M.	—2°.5 C.	February 8	8h.0 P.M.	—7°.5 C.
22	7.0 A.M.	—9.0	9	4.0 A.M.	—11.8
22	8.0 A.M.	—7.0	9	6.0 A.M.	— 9.0
February 8	4.0 P.M.	—2.0	9	7.0 A.M.	— 7.0
8	6.0 P.M.	—4.0	9	8.0 A.M.	— 5.8

[1] The longer cistern barometer (I.) read 506mm.3 at temperature +9°.2 C.

[2] The cistern barometer I. read 505mm.8 at temperature +10.0 C.

OBSERVATIONS OF HORIZONTAL AND VERTICAL ANGLES.

All observations of altitudes and horizontal angles, except the measurement of the elevation of the highest peak above the edge of the crater, were made with the instrument of Ertel, before described. One division of the level of this instrument corresponds to three seconds.

For the determination of the elevation of the highest peak of "Popocatepetl" above the crater, a small theodolite, belonging to the set of Smithsonian magnetic instruments, was used. It had a vertical circle reading to single minutes.

OBSERVATIONS OF VERTICAL ANGLES.

RANCHO TLAMACAS, January 23, 1857.—Ertel's altitude and azimuth instrument.

STATION A.

Object.	Position of circle.	Level.	Circle reading.	Means.	
Popocatepetl, West peak.	Right	6.2	20° 19′ 25″	19′ 26″.2	
			5		
		7.2	35	Level +1.5	
			40		
					20° 19′ 12″.0
"	"	6.8	20 18 60	18 56.3	
			75		
		6.8	50	. 0.0	
			40		
"	Left	6.0	338 57 25	57 47.5	
			55		
		7.2	70	+ 1.8	
			40		
					338 57 36.9
"	"	6.0	338 57 40	57 23.7	
			35		
		6.5	10	+ 0.8	
			10		
		.			
Point of zenith on the circle					359 38 24.4
Altitude of WEST PEAK					20 40 47.6
Popocatepetl, East peak.	Right	6.0	18 57 25	57 25.0	
			30		
		7.3	20	+ 1.9	
			25		
					18 57 33.2
"	"	6.5	18 57 40	57 38.8	
			30		
		6.9	30	+ 0.6	
			55		
"	Left	5.8	340 18 60	18 50.0	
			70		
		7.3	30	+ 2.2	
			40		
					340 18 55.0
"	"	7.0	340 18 70	18 58.8	
			75		
		6.3	40	— 1.0	
			50		
Point of zenith on the circle					359 38 14.1
Altitude of EAST PEAK					19 19 19.1

STATION A—Continued.

Object.	Position of circle.	Level.	Circle reading.	Means.	
Pico del Fraile.	Right	6.3	19° 5′ 40″	5′ 25″.0	
			20		
		6.7	10	+ 0.6	19 5 25.6
			30		
"	Left	6.5	340 10 65	10 53.8	340 10 54.2
			70		
		6.8	40	+ 0.4	
			40		
	Point of zenith on the circle				359 38 9.9
	Altitude of PICO DEL FRAILE				19 27 15.7
Cerro Tlamacas.	Right	6.3	12 18 40	18 15.0	
			10		
		6.8	0	+ 0.7	12 18 15.7
			10		
"	Left	5.8	346 58 10	58 3.8	
			25		
		7.6	0	+ 2.7	346 58 6.5
			57 40		
	Point of zenith on the circle				359 38 11.1
	Altitude of CERRO TLAMACAS				12 40 4.6

STATION B.

Object.	Position of circle.	Level.	Circle reading.	Means.	
Station A (3.9 feet above the ground).	Right	7.5	356° 14′ 60″	14′ 51″.2	356 14 49.0
			30		
		6.0	40	Level 2.2	
			75		
"	Left	6.0	1 34 45	34 53.7	1 34 55.5
			60		
		7.2	80	+ 1.8	
			30		
	Point of zenith on the circle				358 54 52.2
	Depression of Station A				2 40 3.3
East peak.	Right	6.4	18 0 40	0 20.0	18 0 21.0
			10		
		7.1	0	+ 1.0	
			30		
"	Left	6.0	339 50 25	50 28.7	339 50 30.5
			50		
		7.2	10	+ 1.8	
			30		
	Point of zenith on the circle				358 55 25.7
	Altitude of EAST PEAK				19 4 55 3
West peak.	Right	6.7	19° 31′ 50″	31′ 40″.0	19° 31′ 40″.3
			35		
		6.9	20	+ 0.3	
			55		
"	Left	7.5	338 20 30	20 5.0	338 20 2.8
			20 0		
		6.0	19 50	— 2.2	
			20 0		
	Point of zenith on the circle				358 55 51.5
	Altitude of WEST PEAK				20 35 48.8
Pico del Fraile.	Right	6.8	18 23 40	23 40.0	18 23 40 0
			30		
		6.8	35	0.0	
			55		
"	Left	6.8	339 26 50	339 26 31.2	339 26 31.2
			50		
		6.8	10	0.0	
			15		
	Point of zenith on the circle				358 55 5.6
	Altitude of PICO DEL FRAILE				18 28 34.4

OBSERVATIONS OF HORIZONTAL ANGLES.

Rancho Tlamacas, January 24, 1857.—Ertel's altitude and azimuth instrument.

Station A.

Object.	Circle readings.				Means.	
Station B.	119° 6′ 20″	7′ 15″	6′ 50″	6′ 20″	119° 6′ 27″.5	119° 6′ 48″.1
	30	15	50	25	7 23.7	
	40	35	65	45	6 53.7	
	20	30	50	20	6 27.5	
Pico del Fraile.	39 44 20	45 20	43 20	43 50	39 44 33.7	39 44 10.6
	40	0	0	40	45 11.2	
	30	10	10	40	43 11.2	
	45	15	15	55	43 46.2	
West peak.	32 3 15	2 15	1 10	0 65	32 3 15.0	32 1 48.7
	10	0	0 50	50	2 6.2	
	20	0	0 50	50	0 57.5	
	15	10	1 0	60	0 56.3	
East peak.	20 52 10	50 40	49 40	49 50	20 52 8.7	20 50 30.2
	0	30	25	40	50 35.0	
	5	30	30	40	49 33.7	
	20	40	40	45	49 43.7	

Angle B, Pico del Fraile	79° 22′ 37″.5	B to the right.
" B, West peak	87 4 59.4	" "
" B, East peak	98 16 17.9	" "

Station B.[1]

Object.	Circle readings.				Means.	
Station A.	177° 24′ 45″	24′ 30″	23′ 25″	24′ 30″	177° 24′ 51″.7	177° 24′ 22″.7
	50	30	30	40	24 33.3	
	60	40	33	40	23 29.3	
					24 36.7	
East peak.	256 35 35	34 40	34 40	34 20	256 35 35 0	256 34 50.4
	30	40	50	20	34 36.7	
	40	30	40	40	34 43.3	
					34 26.7	
West peak.	267 51 30	50 50	52 20	51 50	267 51 26.7	267 51 35.0
	30	50	30	40	50 46.7	
	20	40	20	40	52 23 3	
					51 43.3	
Pico del Fraile.	275 0 5	0 0	0 50	—	275 0 1.7	275 0 16.1
	0	10	40		0 3.3	
	0	0	40		0 43.3	

Angle A, East peak	79° 10′ 27″.7	A to the left.
" A, West peak	90 27 12.3	" "
" A, Pico del Fraile	97 35 53.4	" "

Length of base line 173^{m}.206 ± 0^{m}.066.
Direction of base line N. 95° 32′ W. (true).

[1] At this station only 3 verniers were read.

OBSERVATIONS OF VERTICAL ANGLES.

PLAIN ON THE IXTACCIHUATL, February 4, 1857.—Ertel's altitude and azimuth instrument.

STATION A.

Object.	Position of circle.	Level.	Circle reading.	Means.	
Ixtaccihuatl, Highest peak.	Right	6.6	16° 12′ 30″	12′ 12″.5	
			0		
		6.9	10	Level + 0.4	
			10		
					16° 12′ 10″.5
"	"	6.4	16 12 20	12 7.5	
			11 55		
		6.8	12 5	+ 0.6	
			10		
"	Left	6.4	341 40 85	40 58.8	
			40		
		6 9	45	+ 0.7	
			65		
					341 41 2.5
"	"	6.2	341 40 90	41 3.8	
			45		
		7.3	45	+ 1.6	
			75		
	Point of zenith on the circle . . .			. .	358 56 36.5
	Altitude of HIGHEST PEAK . . .			. .	17 15 34.0
Ixtaccihuatl, South peak.	Right	6.4	13 31 55	31 36 2	13 31 37.1
			20		
		7.0	30	+ 0.9	
			40		
"	Left	6.3	344 21 50	21 15.0	344 21 16.2
			20 55		
		7.1	21 0	+ 1.2	
			15		
	Point of zenith on the circle . . .			. .	358 56 26.6
	Altitude of SOUTH PEAK . . .			. .	14 35 10.5
Popocatepetl, West peak.	Right	6.4	5 27 55	27 37.5	
			30		
		7.2	25	+ 1.2	
			40		
					5 27 35.0
"	"	6.4	5 27 45	27 30.0	
			10		
		7.2	25	+ 1.2	
			40		
"	Left	7.3	352 27 25	26 28.8	352 26 27 2
			26 0		
		6 2	10	— 1.6	
			20		
	Point of zenith on the circle . . .			. .	358 57 1.1
	Altitude of POPOCATEPETL . . .			. .	6 30 33.9

STATION B.[1]

Object.	Position of circle.	Level.	Circle reading.	Means.	
Ixtaccihuatl, Highest peak.	Left	5.8	341° 33′ 50″	33′ 25″.0	
			0		
		7.1	20	Level + 1.9	
			30		
					341° 33′ 24.2″
"	"	5.4	341 33 40	33 18.8	
			0		
		7.2	15	+ 2.7	
			20		
"	Right	7.2	16 18 70	18 55.0	
			30		
		5.4	50	— 2.7	
			70		
					16 18 55.4
"	"	6.8	16 18 80	19 0.0	
			30		
		5.8	50	— 1.5	
			80		
	Point of zenith on the circle				358 56 9.8
	Altitude of the HIGHEST PEAK				17 22 45.6
Ixtaccihuatl, South peak.	Left	6.3	344 21 60	21 32.5	344 21 32.8
			20		
		6.5	20	+ 0 3	
			30		
"	Right	6.3	13 29 90	30 5.0	13 30 4.4
			50		
		5.9	45	— 0.6	
			75		
	Point of zenith on the circle				358 55 48.6
	Altitude of SOUTH PEAK				14 34 15.8
Popocatepetl, West peak.	Left	7.3	352 30 10	29 55.0	
			29 40		
		5.1	29 50	— 3.3	
			30 0		
					352 29 43.1
"	"	8.0	352 30 10	29 40.0	
			29 10		
		4.3	29 35	— 5.5	
			29 45		
"	Right	5.3	5 23 30	23 8.7	
			22 40		
		7.0	23 10	+ 2.5	
			23 15		
					5 23 37.5
"	"	6.3	5 24 10	24 3.8	
			23 20		
		6.4	24 20	+ 0.1	
			24 25		
	Point of zenith on the circle				358 56 40.3
	Altitude of POPOCATEPETL				6 26 57.2

[1] The altitude of this station, seen from station A, is 2° 45′.

OBSERVATIONS OF HORIZONTAL ANGLES.

PLAIN ON THE IXTACCIHUATL, February 4, 1857.—Ertel's altitude and azimuth instrument.

STATION A.

Object.	Circle readings.				Means.	
Station B.	49° 22′ 60″	23′ 35″	23′ 30″	23′ 10″	49° 23′ 1″.2	
	50	30	20	5	23 36.2	
	75	40	40	25	23 30.0	
	60	40	30	25	23 16.2	
"	49 23 10	22 45	22 50	23 30	49 23 8.8	49° 23′ 13″.4
	0	30	40	45	22 41.2	
	15	55	65	45	22 53.8	
	10	35	60	40	23 40.0	
Ixtaccihuatl, Highest peak.	113 12 40	12 45	12 45	12 35	113 12 25.0	
	25	40	50	30	12 37.5	
	30	45	70	65	12 48.8	
	5	20	30	25	12 38.8	
"	113 12 40	12 35	12 20	11 70	113 12 30.0	113 12 26.8
	30	25	10	50	12 26.2	
	40	35	25	60	12 11.2	
	10	10	11 50	50	11 57.5	
Ixtaccihuatl, South peak.	130 37 50	37 50	37 60	37 70	130 37 47.5	130 37 54.7
	50	40	60	60	37 51.2	
	45	70	65	75	37 56.2	
	45	45	40	50	38 3.8	
Popocatepetl, West peak.	197 55 20	55 20	55 55	55 70	197 55 15.0	
	25	20	50	60	55 12.5	
	5	0	30	40	55 43.7	
	10	10	40	60	55 57.5	
"	197 55 40	55 50	55 60	55 50	197 55 30.0	197 55 36.0
	35	40	55	40	38.8	
	15	30	40	25	52.5	
	30	35	55	35	37.5	

STATION B.

Object.	Circle readings.				Means.	
Station A.	91° 14′ 10″	14′ 20″	14′ 5″	13′ 60″	91° 14′ 10″.0	
	5	15	20	50	14 21.2	
	20	30	30	70	14 17.5	
	5	20	15	60	14 0.0	
"	91 14 20	14 20	13 50	13 50	91 14 12.5	91° 14′ 6″.7
	5	10	50	40	14 16.2	
	20	25	60	45	13 50.0	
	5	10	40	50	13 46.2	
Popocatepetl, West peak.	60 3 10	3 5	3 35	3 0	60 3 11.2	
	0	0	35	10	3 6.2	
	20	15	50	30	2 40.0	
	15	5	40	10	3 12.5	
						60 2 52.2

Station B—Continued.

Object.	Circle readings.				Means.	
Popocatepetl, West peak.	60° 3′ 10″	2′ 20″	2′ 10″	3′ 0″	60° 3′ 5″.0	
	2 50	20	10	0	2 27.5	
	3 10	40	20	10	2 12.5	
	3 10	30	10	0	3 2.5	
Ixtaccihuatl, South peak.	353 55 20	54 40	55 40	54 65	353 55 10.0	353° 55′ 2″.2
	0	20	15	40	54 33.8	
	10	35	35	50	55 30 0	
	10	40	30	65	54 55.0	
Ixtaccihuatl, Highest peak.	336 30 30	30 40	30 45	30 50	336 30 25.0	
	20	30	30	25	30 30.0	
	25	20	20	50	30 31.2	
	25	30	30	30	30 38.8	
						336 30 23.2
"	336 30 35	29 60	30 40	30 45	336 30 21.2	
	10	30	20	15	29 45.0	
	20	40	20	20	30 25.0	
	20	50	20	40	30 30.0	

At Station A.

Angle B, Highest peak	63° 49′ 13″.4
Angle B, South peak	81 14 41.3
Augle B, Popocatepetl	148 32 22.6

At Station B.

Angle A, Popocatepetl	31 11 14.5
Angle A, South peak	97 19 4.5
Augle A, Highest peak	114 43 43.5

Length of base line $150^{m}.433 \pm 0^{m}.062$.
Direction of base line N. 7° 0′ E. (true).

Altitude of the West peak of Popocatepetl above the cave in the crater.
February 8, 1857. Small theodolite (3.5 feet above the ground).

Station A.

Depression of the cave in the crater	32° 20′
Distance of the cave from station A $20^{m}.4$.	
Angle B, West peak	44 11
Altitude of West peak	15 43
Altitude of station B	9 23

Station B.

Angle A, West peak	129 37
Altitude of West peak	16 4.5

Length of base line $73^{m}.40$.

COMPUTATION OF HEIGHTS.

Popocatepetl.—Only a few of the barometrical observations in the city of Mexico were made at exactly the same time as the observations at Tlamacas, and at the trigonometrical station of the Ixtaccihuatl. For this reason all barometer readings made on the same day have been reduced to the mean height of the mercurial column at the freezing point for that day, and the differences of level deduced from the means of the observations thus corrected. The reduction was made by means of the following tables.

CORRECTION TO BE APPLIED TO THE HOURLY READINGS TO REDUCE THEM TO THE MEAN HEIGHT OF THE BAROMETER DURING THE DAY, FROM JANUARY 20 TO FEBRUARY 10.

Hour.	Correction.	Hour.	Correction.	Hour.	Correction.	Hour.	Correction.
City of Mexico.							
8h A. M.	—0mm.55	12h M.	—0mm.14	4h P. M.	+1mm.19	8h P. M.	—0mm.60
9 A. M.	—0.93	1 P. M.	+0.11	5 P. M.	+0.80	9 P. M.	—0.80
10 A. M.	—0.65	2 P. M.	+0.44	6 P. M.	+0.30	10 P. M.	—0.89
11 A. M.	—0.40	3 P. M.	+0.85	7 P. M.	—0.24	11 P. M.	—0.76
Rancho Tlamacas and trigonometrical station on the Ixtaccihuatl.							
8 A. M.	—0.15	12 M.	—0.20	4 P. M.	+0.60	8 P. M.	—0.46
9 A. M.	—0.55	1 P. M.	—0.04	5 P. M.	+0.66		
10 A. M.	—0.51	2 P. M.	+0.20	6 P. M.	+0 36		
11 A. M.	—0.43	3 P. M.	+0.42	7 P. M.	—0.06		

The table for the city of Mexico has been deduced from observations of days on which the mean height of the barometer was nearly the same as on the preceding and following days.

The other table has been interpolated from observations at Tlamacas, and at the foot of the Ixtaccihuatl.

Barometrical observations, which I made at very different heights in several parts of the Mexican Republic, seem to indicate that the daily maximum and minimum set in later in proportion as we ascend higher, at the rate of about six minutes for every thousand feet change in elevation. I computed, therefore, from the table of corrections for the city of Mexico, a table corresponding to a height of 12,500 feet, by supposing the time of maximum and minimum at this height half an hour later than in Mexico, and reducing the corrections; then interpolated from the table for the city of Mexico, in proportion to the mean daily range of the two stations, which was assumed to be 0.615. In this way the following table was obtained.

CORRECTION OF HOURLY OBSERVATIONS, CORRESPONDING TO A HEIGHT OF 11,600 TO 12,800 ENGLISH FEET.

Hour.	Correction.	Difference.	Hour.	Correction.	Difference.	Hour.	Correction.	Difference.
8h A. M.	—0mm.22	+0mm.07	12h M.	—0mm.17	—0mm.03	4h P. M.	+0mm.68	—0mm.08
9 A. M.	—0.50	—0.05	1 P. M.	—0.01	—0.03	5 P. M.	+0.67	—0.01
10 A. M.	—0.54	+0.03	2 P. M.	+0.17	+0.03	6 P. M.	+0.34	+0.02
11 A. M.	—0.32	—0.11	3 P. M.	+0.39	+0.03	7 P. M.	+0.02	—0.08

The column headed "Difference" shows the differences of the values in this table from those in the table interpolated from actual observations. These differences would have been much greater and more irregular, if the time of maximum and minimum had been assumed to be the same at both elevations.

The heights have been computed by the tables of Gauss; some of them were recomputed by Delcros' tables, published in the Smithsonian Miscellaneous Collections. It was found that in a single case only the difference between the two tables amounted to three feet, hence it was not thought necessary to alter the results found by Gauss' tables.

The height upon which all other elevations are based, namely, the—

City of Mexico (plaza) was assumed above the Mexican gulf to be . . . . . 7472.8 Eng. feet.

This value is the mean between Humboldt's determination and my own, deduced from two month observations by myself, in Mexico, and from corresponding observations by Dr. Berendt, in Vera Cruz. There is a difference of only three feet between the two values.

The observations at the Rancho Tlamacas give—all reduced to the trigonometrical station A—

Tlamacas, trigonometrical station A, above Mexico . . 5319.6 feet.
" " " " above the Mexican gulf . 12792.4 "

The barometrical observations at the bottom of the crater give—

Bottom of crater, above Mexico . . . . . 9322.7 feet.
" " above the Mexican gulf . . . . 16795.5 "

And the observations at the cave in the crater give—

Cave in the crater, above Mexico . . . . 9830.0 feet.

The computation of the depression of the cave, measured at station A, near the edge of the crater, gives—

Cave, below station A . . . . . 32.3 feet.

And the small triangle, measured at the edge of the crater, gives—

Highest peak of Popocatepetl, above station A . . . 482.5 feet.
" " " " above Mexico . . . 10344.8 "
" " " " above the Mexican gulf . . 17817.6 "

The triangulation at Rancho Tlamacas gives two values for the height of each point of the Popocatepetl, one for each station. The reduction of the heights,

observed at station B, to those of station A, is + 26.42 feet. This correction applied, the results are—

HEIGHTS ABOVE STATION A.

From observations—	Western peak.	Eastern peak.	Pico del Fraile.
At station A	4985.05	4387.07	3766.43
At station B	83.34	87.32	65.70
Mean	4984.20	4387.20	3766.06
Correction[1]	+7.07	+6.78	+5.78
Height above station A	4991.27	4393.98	3771.84

HEIGHTS ABOVE THE LEVEL OF THE MEXICAN GULF.

POPOCATEPETL,	Highest (Western) peak	17783.7 English feet.
"	Eastern peak	17186.4 " "
"	Pico de Fraile	16564.2 " "

The highest peak is, according to this triangulation, 33.9 feet lower than it was found from the barometrical measurement at the cave in the crater, but the smaller value is probably the more accurate, and has been adopted. These heights, as also those of the Ixtaccihuatl, differ several feet from those found by a first computation, and communicated by me to Baron von Müller[2] and M. Leverrier, who published them in Dr. Petermann's "Geographische Mittheilungen," and other periodicals. The difference was caused by an error in the former reduction of the base line to the horizon, and some other accidental error.

IXTACCIHUATL.—The height of the trigonometrical station B on the foot of the Ixtaccihuatl was found to be 4124.4 feet above the city of Mexico, or—

STATION B, above the Mexican gulf . . . . 11597.2 Eng. feet.

The reduction of station A to station B was found to be 23.68 feet. This gives the elevations of the three points, of which the altitudes have been observed, as follows:—

HEIGHTS ABOVE STATION B.

From observations—	Highest peak.	South peak.	Popocatepetl.
At station A	5470.88	5049.25	6089.13
At station B	68.85	49.49	6103.41
Means	5469.86	5049.37	6096.27
Correction	+9.82	+11.30	+63.50
Height above station B	5479.68	5060.67	6159.77

HEIGHT ABOVE THE LEVEL OF THE MEXICAN GULF.

IXTACCIHUATL,	Highest peak	17076.9 English feet.
"	South peak	16657.9 " "
POPOCATEPETL,	West peak	17757.0 " "

[1] This correction includes the effect of curvature, terrestrial refraction, and the height of the instrument above the ground.

[2] Baron von Müller has, by mistake, given the height of the Eastern peak [Espinazo del diablo] for that of the Western or highest peak [Pico mayor].

This makes the Popocatepetl 26.7 feet lower than the determination at Tlamacas, a quantity within the limits of error, to which the last determination is liable, as the two lines, drawn from the Popocatepetl to the ends of the base line *A B* on the foot of the Ixtaccihuatl, form an angle of only 16′ 23″ with each other.

Miscellaneous Heights.—The barometrical observations at Amecameca give—

Amecameca (plaza) above the city of Mexico	709.0	Eng. feet.
" above the Mexican gulf	8181.8	"

The observations at Sacremonte, if compared with those made at Amecameca on the same day, after applying the correction for the hours of observation, give—

Sacremonte, above Amecameca	420.6	Eng. feet.
" above the Mexican gulf	8602.4	"

The lowest depression in the ridge, connecting the Popocatepetl and Ixtaccihuatl, which is identical with the highest point of the road from Puebla to Amecameca, was found to be 12,118 English feet above the sea.

The junction of the roads from Puebla and Tlamacas to Amecameca is 11,485 English feet above the level of the sea, and the absolute height of a cascade on the Ixtaccihuatl, where ice remains all the year, was found to be 12,788 Eng. feet.

The height of Cerro Tlamacas is 13,359 "

Vegetation does not extend within 200 feet of the top of this mountain.

The heights of a considerable number of points on the western slope of the mountain ridge have been determined for the purpose of constructing a map. The method employed consisted generally in taking bearings from the point itself to two known objects, one of these was always Sacremonte, near Amecameca, which is very prominent, the other, either the Ixtaccihuatl or the Popocatepetl. The position of the point was thus fixed. Afterwards the small theodolite was mounted on Sacremonte, and the altitudes of the different points determined, which were easily recognized by the bearings, formerly taken from them to Sacremonte. The heights, obtained by this method, are sufficiently accurate for the purpose for which they were intended.

To render comparisons with other determinations of the principal heights more convenient, the results have been changed into metres and collected in the following table:—

HEIGHTS ABOVE THE LEVEL OF THE MEXICAN GULF.

Popocatepetl.		Ixtaccihuatl.	
Western (Highest) peak	5420^{m}.4	Highest peak	5204^{m}.9
Eastern peak	5238.3	South peak	5077.2
Pico del Fraile	5048.7	Trigonometrical station B	3534.8
Bottom of crater	5119.2	Highest point reached	5010.9
Trigonometrical station at Tlamacas	3899.2		
Amecameca (plaza)	2493.8		
Mexico City (plaza)	2277.7		

This height of Mexico is sixty metres different from the height determined by Messrs. Truqui and Craveri (Petermann's Geogr. Mittheilungen, 1856, page 360). The difference seems to be caused by an extremely low period of the barometer in

Vera Cruz during the time in March, when Mr. Craveri was observing. He gives as the mean height of the barometer 759^{mm}.16 at the temperature 24°.79. If we suppose this to be Centigrade, the mean height, reduced to the freezing point, would be 756^{mm}.12, or reduced to the level of the sea, 757^{mm}.12 (the barometer being 11^{m}.5 above the sea). But the mean height of the barometer in March is, in the northern tropics, above the annual mean, which is at Vera Cruz (reduced to the level of the sea and to the freezing point) 760^{mm}.5, according to the observation of Dr. Berendt, which have been continued for nearly three years. If we suppose (as is the case in Havana) the mean height of the barometer in March to be 0^{mm}.7 above the mean of the year, this height would become 761^{mm}.2, or 4^{mm}.08 higher than that M. Craveri observed; this would make the city of Mexico 46.3 metres higher, and come within 14 metres of Humboldt's determination and my own.

GEOGRAPHICAL POSITIONS.

At the Rancho Tlamacas I made several sets of circum-meridian observations of the sun for determining the latitude, and also observations of equal altitudes in the forenoon and afternoon for obtaining the local time; as I had only one pocket chronometer, the rate of which was rather irregular in consequence of being transported on horseback, the last observations are of no value for the determination of the difference of longitude between the Popocatepetl and the city of Mexico. I have, therefore, given the longitudes of the different points, as deduced from the triangulation, upon the western or highest peak of the Popocatepetl. The observations were made with the instrument of Ertel, the circle being mounted vertically.

The latitude from two sets of circum-meridian observations of the sun, was found to be for—

Rancho Tlamacas, trig. station A.	19° 3′ 0″.0 N.

The co-ordinates of the principal points of the Popocatepetl, taking station A as zero point and supposing X positive when west, Y when north of A, were found to be for—

	Western peak.	Eastern peak.	Pico del Fraile.
X	— 603 feet.	— 2986 feet.	+ 945 feet.
Y	13193 "	—12152 "	—10621 "

From the first two sets of co-ordinates, combined with the difference of height of the eastern and western peak (597.3 feet), was computed the—

Upper diameter of the crater	2668 Eng. feet.
Direction of this diameter	S. 66°·24′ W. (true).

The diameter of the level part of the bottom of the crater, running from north to south, was estimated by pacing to be 750 feet.

The co-ordinates of the principal points determined at the trigonometrical station on the Ixtaccihuatl, referred to station B as zero point, are—

	Ixtaccihuatl.		Popocatepetl.
	Highest peak.	South peak.	Western peak.
X	—16643 feet.	—19425 feet.	—22123 feet.
Y	+ 5322 "	+ 107 "	—49254 "

Or, if all co-ordinates are referred to the western peak of the Popocatepetl as zero point, the results are as follows:—

	$x \left\{ \begin{matrix} +\text{West} \\ -\text{East} \end{matrix} \right.$	$y \left\{ \begin{matrix} +\text{North} \\ -\text{South} \end{matrix} \right.$
Popocatepetl, Western peak	0	0
" Eastern peak	— 2383	+ 1041
" Pico del Fraile	+ 1548	+ 2572
Tlamacas, station A	+ 603	+13193
Ixtaccihuatl, Highest peak	+ 5480	+54576
" South peak	+ 2698	+49361
" station B	+22123	+49254

These co-ordinates, changed into minutes and seconds of arc, give the following—

GEOGRAPHICAL POSITIONS.

	Longitude.	Latitude N.
Popocatepetl, Western peak	0″.0	19° 0′ 49″.2
" Eastern peak	24.8 E.	19 0 59.6
" Pico del Fraile	16.1 W.	19 1 14.7
Rancho Tlamacas	6.3 W.	19 3 0.0
Ixtaccihuatl, Highest peak	57.1 W.	19 9 50.2
" South peak	28.1 W.	19 8 58.5
" station B	3′ 50.7 W.	18 8 57.4

MISCELLANEOUS NOTES.

In ascending from the low-lands, which are elevated but little above the level of the sea, into the higher mountainous regions, the interval between two successive respirations decreases in proportion as the air becomes more rarefied. This fact may be accounted for by assuming that the lungs always require nearly the same quantity of air in weight, and this quantity increases in volume in the same ratio, as the density of the air decreases, but we cannot draw a larger volume of air in a single breath on a high mountain than at the level of the sea.

In Mexico, near the level of the sea, I found that I breathed from twenty-two to twenty-three times in a minute (the barometer standing at 760 millimetres or 30 inches), while in the city of Mexico, with the barometer at 588 millimetres or 22.5 inches, the number of respirations in a minute was increased from twenty-seven to thirty; at the Rancho Tlamacas the barometer at 484 millimetres, the number was from thirty-three to thirty-six, and at the crater of the Popocatepetl with the barometer at 406 millimetres, the respirations were from forty to forty-four.

Another series of observations of a similar character relative to the frequency of the pulse, gave the following results: Near the level of the sea I counted from sixty-four to seventy-four; at a height of 7500 English feet above the sea from seventy-five to eighty-four; at 12,800 English feet elevation from eighty-six to ninety-four, and at the crater of the Popocatepetl, 17,300 feet above the level of the sea, from ninety-six to one hundred pulsations in a minute.

The observations on the frequency of respiration and on the pulsations, were made only when I felt perfectly well, and was not in the slightest degree excited; generally after several hours' rest, and in the crater of the Popocatepetl early in the morning, before rising, after I had been sleeping ten hours or more. Persons who are accustomed to live in low countries, experience considerable inconvenience for some time after their arrival on the high plateau, in consequence of this acceleration of respiration, which is particularly felt at every exertion, for instance in walking up hill, or only up stairs, in raising heavy weights, etc.; but after they have lived for several months at these elevations, their breathing and pulsations again become slower. The natives of the high table-lands probably do not breathe any faster or have more frequent beats of the pulse than the natives of the countries near the coast, owing perhaps to an increased capacity of the lungs.

Similar observations have also been made on different animals, particularly on horses and dogs, which had been imported from the low countries. Race horses and gray hounds for instance, brought over from the United States and England, have not the same speed on the high plains of Mexico as in their native country. This, however, does not affect the fleetness of their offspring, if born and raised on the high lands.

At an elevation of more than 11,000 feet, a person in a good state of health never perspires, not even after great exertions; and in an artificially increased temperature, only a feverish heat is experienced. Even at the height of the city of Mexico, anything more than a slight perspiration is rarely felt. It has been before stated, that I never observed a case of bleeding of the nose, whilst ascending very high mountains, but generally headache, accompanied by a painful sensation in the eyes, which swell out considerably, is felt. The odor of sulphur, besides the rarefied air, is one of the principal causes of this pain, as it is much more severe at the bottom of the crater of the Popocatepetl than near its edge or outside.

During the rainy season, from June to September, the tops of the higher mountains are rarely seen, as they are almost constantly enveloped in clouds or fog, produced by the contact of the warm air (at this season, nearly saturated with humidity) with the cold, partially snow-covered surface of the moun-

tains. The chilled air is not able to contain the same quantity of aqueous vapor, and part of it becomes visible as fog or snow. From June 18 to 22, 1857, I was delayed at the Rancho Tlamacas on the foot of the Popocatepetl, at an elevation of 12,800 feet, for three days, the fog being so dense that we could scarcely see at twenty yards distance; an image of the camp-fire, at night time, being reflected from it. It snowed continually, while the thermometer during the day was about two degrees F. above, and at night as much below the freezing point.

During the dry season, from October till May, the atmosphere of the high-lands is always clear, except when northerly winds blow; but generally about nine or ten o'clock in the mornings, mist begins to form around the highest mountain peaks and accumulates rapidly, so that at eleven o'clock those parts of the mountains, which are elevated more than 13,000 feet, are entirely wrapped in clouds. Small floating clouds, which form sometimes in the vicinity, in calm weather generally unite with the larger masses which envelope the peaks. In the afternoon these clouds sink lower down, and the upper snow-covered part becomes visible again above them a short time before sunset. At this time they appear most beautiful, tinged with a rosy, or sometimes of a reddish golden color, but immediately after sunset these brilliant tints change into a dull lead color (bluish gray), and the clouds entirely disperse about this time, only occasionally a light mist being noted in the valleys and on the meadows during the evening. There are, however, times, particularly in January and February, when not a cloud is seen near the mountains for two or three days in succession.

The cumulus-clouds never extend much above the highest mountain-peaks, and their greatest height probably does not exceed 20,000 English feet. At greater elevations cirrus-clouds only are observed, which appear here of a purer white color than when they are seen from the low-lands. This lighter appearance is probably caused in a great measure by their contrast with the sky, which is here of a darker blue than near the level of the sea. I had no means of estimating accurately the height of the cirrus-clouds, but from their size and appearance, which do not differ sensibly from that which they exhibit near the level of the sea, as also from their slow motion, it would appear that they were at least from three to five miles above the station of observation, or from six to eight miles above the level of the sea.

A sensible effect of the rarefaction of the air on the duration of the twilight is also observed; twenty minutes after sunset, stars of the fifth magnitude become visible, and fifteen minutes later the last traces of twilight disappear on the western horizon. If the air is calm the stars appear in a quiet, planetary light, and lose very little of their brightness as they approach the horizon. Stars of the sixth magnitude may be still distinguished at an altitude of five degrees.

I have never observed any striking electrical phenomena in heights above 13,000 feet, and during my stay on the high plateau of Mexico, thunder and lightning occurred very rarely. On the plains it rained, during the rainy season, on an average, not more than every third day, and generally only in the afternoon from three to five o'clock, but at this time the fall was occasionally very heavy. The two last seasons (1857 and 1858) were, however, considered by the natives as unusually dry. In the higher mountain ridges (from 10,000 to 13,000 feet elevation) a drizzling rain falls, sometimes for days in succession, increasing generally in the afternoon.

My observations on the limits of animal life are so restricted as to be of little value.

Several classes of birds, among which I noted the raven, are found near the limits of vegetation (13,200 feet), and great numbers of parrots were noted on the western slopes of the peak of Orizaba, at more than 10,000 feet of altitude. Wolves ascend as high, or even higher, than the ravens; and I have seen deer 12,000 feet above the level of the sea.

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

ON

CERTAIN STORMS

IN

EUROPE AND AMERICA,

DECEMBER, 1836.

BY

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ON THE

AMERICAN STORM OF DECEMBER 20, 1836, AND THE EUROPEAN STORM OF DECEMBER 25, 1836.

About twenty years ago, I undertook to investigate the phenomena of a violent storm which swept over the United States about the 20th of December, 1836, and the result of my investigations was published in the *Transactions of the American Philosophical Society*, vol. vii. pp. 125–163. This storm extended from the Gulf of Mexico to an unknown distance on the north. The fluctuation of the barometer increased with the latitude, at least as far as Quebec, the most northern point from which observations could be obtained. The area covered by the observations included, therefore, only the southern half of the storm, and the phenomena of the northern half could only be supplied by conjecture. I, therefore, regarded the results of this investigation as unsatisfactory; but being unable to obtain observations from more northern stations, I published the information which I had obtained, and sought for a more hopeful subject of investigation in the case of some storm which was wholly embraced within the area of our observations. Such was the storm of February 4, 1842, with regard to which I fortunately obtained abundant materials for investigation. In conducting this investigation I adopted some peculiar methods, which, so far as I have been informed, had never been practised before. The phenomena of the storm, at intervals of twelve hours, were delineated on a series of maps of the United States, in such a manner that every important feature was made to appeal directly to the eye.

Those portions of the map corresponding to places where the sky was unclouded were colored blue; those portions where the sky was overcast, but without rain or snow, were colored brown; those portions of the country where rain was falling were colored yellow; and those portions where snow was falling were indicated by a green color. The direction of the wind was represented by arrows, and its force indicated by their length.

The observations of the barometer and thermometer were represented in the following manner: Having determined, as well as I was able, the mean height of the barometer at each station, I compared each observation with the mean. I then drew on the map a line connecting all those places where the barometer, at a given hour, stood at its mean height. This line was called the *line of mean pressure*. I then drew a line connecting all those places where the barometer, at the same hour,

stood two-tenths of an inch *above* the mean; another line connecting all those places where the barometer stood four-tenths of an inch above the mean, etc. A line was also drawn connecting all those places where the barometer stood two-tenths of an inch *below* the mean; another line four-tenths of an inch below the mean, etc. These lines may be called *lines of equal barometric disturbance.*

In like manner a line was drawn connecting all those places where the thermometer stood at its mean height for the given hour and month; and this was called the *line of mean temperature.* Another line was drawn connecting all those places where the thermometer stood ten degrees *above* the mean; and other lines were drawn connecting those places where the thermometer was twenty degrees above the mean; ten degrees *below* the mean; twenty degrees below the mean, etc. These lines may be called *lines of equal thermometric disturbance.*

This mode of representing the observations of the barometer and thermometer appears to me the most suitable of any which has yet been proposed, to indicate the connection between the pressure and temperature of the air on the one hand, and the direction of the wind and the fall of rain on the other.

The results of the investigation of the storm of February 4, 1842, were entirely satisfactory to myself, and were published in the *Transactions of the American Philosophical Society*, vol. ix. pp. 161–184. Being convinced of the superior advantages of this new method of investigating the phenomena of storms, I immediately constructed upon the same principle a series of maps, representing the progress of the storm of December 20, 1836; and I perceived that certain features of this storm were thus brought out more clearly than I had been able before to exhibit them; but their publication has hitherto been delayed by the serious expense attending the preparation of a series of colored maps. As, however, my paper upon this storm has been commented upon by Messrs. Espy, Hare, and Redfield, and some conclusions have been drawn from it which appear to me unwarranted, I have thought it important that the maps should be published, with some accompanying remarks sufficient for their explanation.

Before issuing this reinvestigation of the storm of December 20, 1836, I have employed every means in my power for obtaining additional observations, and have met with some success. I have obtained copies of meteorological journals, including barometric observations, from the following stations, in addition to those employed in my first investigation:—

Station.	Latitude.	Longitude.	Observer.
Fort Snelling . . .	44° 53′	93° 12′	J. N. Nicollet.
New Orleans . . .	29 57	90 0	Prof. E. H. Barton.
Cincinnati	39 6	84 27	Prof. Joseph Ray.
Portsmouth, Ohio . .	38 42	82 54	Dr. G. L. B. Hempstead.
Steubenville, Ohio . .	40 25	80 40	Roswell Marsh.

About the 25th of December, 1836, a remarkable storm was experienced over nearly the entire continent of Europe, and some meteorologists supposed that this storm was the same as the American storm of December 20th. In order to prosecute this inquiry, I collected European meteorological journals for this period as far as they were within my reach. These stations were twelve in number, and a

synopsis of the results was published in 1840, as a part of my first paper above referred to. This examination did not favor the supposition of any intimate connection between the American storm of December 20th and the European storm of December 25th; nevertheless, the observations were too few in number to indicate all the phenomena of the European storm. During a visit to Europe in 1856 and 1857, I improved the opportunity to collect additional observations for December, 1836, and succeeded in obtaining barometric observations from twenty-five additional stations, besides a few registers which were deficient in observations of the barometer. Having projected these observations upon a series of maps in the manner described with reference to the storm of February 4, 1842, I perceived that the phenomena of this storm were very remarkable, differing in some respects from any which I had previously seen investigated, and I then resolved to make a further effort to obtain materials for rendering the investigation in all respects complete. I accordingly addressed letters to twenty-five meteorologists in different countries of Europe, soliciting copies of their journals for the period in question. In answer to these letters I have received observations from twelve additional stations, so that now I have barometric observations from forty-seven stations, extending over nearly every country of Europe. I propose to present a summary of these observations, after first examining the American storm.

AMERICAN STORM OF DECEMBER 20, 1836.

Observations of the Barometer.

The following table presents a summary of the observations of the barometer at each of the American stations: column first shows the name of the station; columns second and third their latitude and longitude; and column fourth the mean height of the barometer at each station. The numbers in this column have been derived in the following manner: For all those stations where there has been made a series of observations extending over several years, the mean of this series, whenever it could be ascertained, has been inserted in column fourth. For the remaining stations the assumed mean height is that due to the supposed height of the station above the sea, corrected in some cases by comparison of the observations made simultaneously at neighboring stations where the mean height of the barometer was pretty well determined. The fluctuations of the barometer were required for 8 A. M. and 8 P. M. of each day; and whenever these hours did not correspond to the actual hours of observation at any station, the height for these hours was interpolated by a comparison of the preceding and subsequent observations. The numbers thus obtained were diminished by the mean height of the barometer for that station, and the remainders are inserted in columns five to twelve; which accordingly show how much the barometer was above or below its mean height for the dates given at the top of the table:—

STATIONS.	Latitude.	Longitude.	Mean height.	BAROMETRIC FLUCTUATIONS.							
				December 19th.		December 20th.		December 21st.		December 22d.	
				8 A. M.	8 P. M.	8 A. M.	8 P. M.	8 A. M.	8 P. M.	8 A. M.	8 P. M.
			Inches.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
Fort Snelling	44° 53′	93° 12′	29.00	.00	—.11	—.14	—.18	+.30	+.41	+.20	—.31
Natchez	31 34	91 24	29.80	+.15	—.01	—.21	+.12	+.48	+.53	+.44	+.24
New Orleans	29 57	90 00	30.09	+.26	+.16	—.01	+.04	+.42	+.50	+.51	+.32
Pensacola	30 24	87 10	30.10	+.25	+.16	+.02	—.04	+.34	+.35	+.36	+.35
Cincinnati	39 6	84 27	29.26	+.29	+.25	—.13	—.64	+.21	+.47	+.49	+.24
Lexington	38 6	84 18	28.99	+.33	+.22	—.06	—.43	+.24	+.43	+.45	+.26
Springfield	39 53	83 48	28.94	+.33	+.16	—.05	—.54	+.08	+.36	+.45	+.26
Portsmouth	38 42	82 54	29.52	+.42	+.23	—.02	—.52	+.16	+.48	+.55	+.23
Marietta	39 25	81 36	29.44	+.41	+.37	+.02	—.37	+.06	+.30	+.55	+.34
Savannah	32 5	81 5	30.26	...	...	+.14	—.11	—.11	+.11	+.54	+.44
Indian Key	24 48	80 55	30.16	+.15	+.07	+.04	+.08	+.08	+.13	+.26	+.13
Steubenville	40 25	80 40	29.45	+.39	+.31	+.12	—.35	—.08	+.27	+.46	+.31
Rochester	43 8	77 51	29.48	+.49	+.48	+.30	+.06	—.45	+.02	+.40	+.47
Washington	38 53	77 00	29.90	+.57	+.52	+.38	+.03	—.41	+.10	+.55	+.46
Sunbury	40 53	76 50	29.47	+.63	...	+.48	+.06	—.37	...	+.63	+.53
Baltimore	39 18	76 37	30.05	+.59	+.53	+.41	—.05	—.44	+.27	+.58	+.46
Syracuse	43 1	76 16	29.59	+.61	+.53	+.35	—.04	—.36	+.20	+.47	+.51
Philadelphia	39 57	75 10	29.90	+.60	+.60	+.55	+.17	—.39	+.10	+.54	+.64
New York	40 43	74 00	30.14	+.61	+.65	+.56	+.23	—.34	+.12	+.50	+.57
Flushing	40 45	73 52	29.97	...	...	...	...	—.34	+.08	+.57	+.62
Albany	42 39	73 44	30.00	+.69	+.62	+.53	+.20	—.50	+.08	+.51	+.55
Montreal	45 31	73 35	29.89	+.60	+.58	+.52	+.24	—.55	+.01	+.46	+.65
New Haven	41 18	72 55	30.05	...	...	...	...	—.20	+.05	+.52	+.64
Hanover	43 42	72 18	29.55	+.57	+.69	+.61	+.42	—.19	+.02	+.41	+.62
Quebec	46 49	71 12	29.54	...	...	+.97	+.71	—.14	—.09	+.72	...
Boston	42 21	71 3	29.98	+.50	+.53	+.60	+.38	.00	—.01	+.37	+.54
New Bedford, C.	41 38	70 55	30.17	+.54	+.65	+.59	+.40	—.05	—.07	+.41	+.55
" R.	41 38	70 55	30.03	...	...	+.63	+.40	—.09	—.04	+.40	+.55
Gardiner	44 10	69 50	29.94	+.50	+.70	+.66	+.57	+.14	—.29	+.40	+.60
Halifax	44 39	63 36	29.85	+.05	+.45	+.45	+.60	+.35	—.05	—.15	—.05
Bermuda	32 34	64 38	30.02	+.43	+.52	+.58	+.52	+.45	+.34	+.20	+.03
St. Johns	47 34	52 38	29.74	—.39	—.20	+.28	+.65	+.71	+.69	+.39	+.12

In accordance with the preceding numbers, the lines of equal barometric disturbance have been drawn upon the five accompanying charts for Dec. 19th, 8 P. M.; Dec. 20th, 8 A. M. and 8 P. M.; and Dec. 21st, 8 A. M. and 8 P. M. On each chart is drawn the line of mean pressure, as well as the line of two-tenths of an inch *below* the mean; two-tenths of an inch *above* the mean, etc. On each of these maps there appears a large area over which the barometer was below its mean height. For convenience we will call this area the area of *low barometer*. On the evening of December 20th this area of low barometer was 980 miles from west to east; on the morning of December 21st it was 770 miles from west to east; and on the evening of December 21st it was 650 miles from west to east. It is evident that towards the north, the area of low barometer extended much beyond the limit of the maps. The greatest observed depression of the barometer (.72 inch) was at Quebec, in latitude 46° 49′; whence it is inferred that the area of low barometer probably extended as far north as it did south of Quebec. On this supposition, the area of low barometer December 21st extended about 3,000 miles from north to south. This area constituted an oblong oval figure whose length was from two to three times its breadth. This figure was not stationary, but travelled constantly eastward.

If the observations embraced the entire area of the storm, we could easily determine the approximate centre of the area of low barometer, and thus assign the

direction and velocity of its motion from day to day. But unfortunately few, if any, observations have been obtained from points north of the centre of the storm. At Fort Snelling, near latitude 45° on the Mississippi river, the entire oscillation of the barometer from the lowest point on the 20th to the highest on the 21st was .67 inch. At Natchez the oscillation was .74 inch, and at New Orleans .61 inch. It may then be inferred that along the valley of the Mississippi river, the centre of the area of low barometer was near St. Louis. But the greatest depression of the barometer anywhere observed was at Quebec. Assuming St. Louis and Quebec to lie upon the central path of the area of low barometer, the direction of its progress was from S. 60° W. to N. 60° E. There can be little doubt that the barometric wave travelled towards some point north of east, and not towards the south of east, as has been inferred by Messrs. Hare and Espy. From the morning of Dec. 20th to the morning of December 21st, the centre of the storm advanced in the direction already assigned 1050 miles, being an average velocity of 44 miles per hour.

Observations of the Thermometer.

The following table presents a summary of the observations of the thermometer at most of the stations. Column first shows the names of the stations; columns second and third their latitude and longitude; and column fourth the mean temperature at each station for the month of December. The mean temperature for the given hours of observation was obtained by applying to the mean temperature of the month a correction for the hour of the day as determined by hourly observations made at Montreal and Philadelphia. This result was subtracted from the observed temperature, and the remainder indicated the number of degrees by which the observed temperature differed from the mean temperature for that hour of December. The fluctuations of the thermometer were required for 8 A. M. and 8 P. M. of each day; and whenever these hours did not correspond to the actual hours of observation at any station, the fluctuations for these hours were interpolated by a comparison of the preceding and subsequent observations. The results are inserted in columns five to twelve, which accordingly show how much the thermometer was above or below its mean height for the dates given at the top of the table:—

STATIONS.	Latitude.	Longitude.	Mean temp. of Dec.	THERMOMETRIC FLUCTUATIONS.							
				December 19th.		December 20th.		December 21st.		December 22d.	
				8 A. M.	8 P. M.	8 A. M.	8 P. M.	8 A. M.	8 P. M.	8 A. M.	8 P. M.
Fort Gibson	35° 48′	95° 15′	40°.8	+ 7°	— 4°	—13°	—30°	—27°	—21°	—10°	+ 4°
Fort Leavenworth	39 21	94 44	29.8	+ 6	+ 4	—30	—33	—33	—22	— 6	+ 2
Fort Towson	34 00	95 33	42.6	+ 3	+ 8	+ 3	—24	—29	—18	—15	+ 1
Fort Jessup	31 33	93 32	49.7	+ 3	+ 8	+18	—12	—29	—22	—24	—10
Fort Snelling	44 53	93 12	16.9	+ 9	+ 7	—15	—25	—35	—35	—19	— 9
Fort Des Moines	41 32	93 38	29.2	— 1	+11	+ 5	—28	—35	—31	—16	0
Baton Rouge	30 26	91 18	54.1	—16	+ 1	+ 9	— 2	—29	—24	...	...
Natchez	31 34	91 24	49.3	— 7	+ 3	+14	— 7	—24	—22	—20	—14
Fort Crawford	43 5	91 00	22.6	+ 4	+12	+15	—23	—35	—29	—21	— 2
Augusta	40 12	91 6	28.4	— 3	+10	+12	—33	—38	—31	—19	— 2
St. Louis	38 37	90 15	33.7	0	+ 8	+ 8	—27	—32	—23	—17	— 1
New Orleans	29 57	90 00	55.7	—10	0	+ 9	— 2	—22	—22	—27	—20
Fort Winnebago	43 31	89 28	21.3	+ 1	+ 8	+14	—22	—35	—37	—24	— 5
Fort Howard	44 30	88 5	21.0	+ 4	+ 7	+17	+ 8	—22	—29	—22	— 3
Pensacola	30 24	87 10	55.6	—10	+ 3	+10	+10	—22	—24	—31	—17
Fort Mitchell	32 19	85 2	52.0	—23	+ 4	+ 2	+ 9	—19	—14	—30	—13
Fort Mackinac	45 51	84 33	23.1	— 1	+ 3	+14	+16	—16	—20	—22	—12
Cincinnati	39 6	84 27	34.1	—23	+ 6	+10	+17	—25	—24	—28	—12
Fort Brady	46 30	84 43	21.5	— 1	+ 3	+14	+15	—11	—20	—28	—13
Lexington	38 6	84 18	36.5	—12	+ 2	+10	+15	—15	—25	—15	—14
Springfield	39 53	83 48	30.8	—17	+ 3	+11	+13	—22	—27	—26	—17
Dearbornville	42 24	83 2	26.9	— 9	+ 4	+ 8	+14	—25	—30	—32	—15
Portsmouth	38 42	82 54	37.9	—22	— 2	+ 4	+12	—19	—18	—19	—14
Fort Gratiot	42 55	82 23	26.6	— 8	+ 5	+11	+17	—20	—25	—23	—12
Marietta	39 25	81 36	34.6	—24	— 7	+ 9	+17	—16	—21	—25	—19
St. Augustine	29 48	81 35	57.2	0	0	+ 5	+ 8	+ 7	—11	—23	—11
Twinsburg	41 20	81 26	30.0	—18	+ 1	+10	+11	—14	—27	—26	— 7
Savannah	32 5	81 5	52.1	...	...	+ 6	+11	+10	— 6	—12	—13
Indian Key	24 48	80 55	70.7	— 1	+ 2	+ 4	+ 5	+ 2	— 3	—10	— 1
Steubenville	40 25	80 40	30.8	—19	— 6	+ 1	+10	—10	—21	—20	—17
Alleghany Arsenal	40 32	80 2	31.3	—26	—10	—10	+10	—11	—20	—25	—21
Charleston	32 46	79 56	51.8	— 9	—15	+ 4	+13	+ 6	—14	—21	—17
Pomfret	42 26	79 24	30.8	—13	— 4	— 2	+12	—11	—19	—19	—16
Lewiston	43 9	79 10	29.7	—14	— 3	+ 3	+10	—13	—20	—27	—14
Rochester	43 8	77 51	28.6	—10	— 4	— 1	+13	— 2	—18	—21	—17
Washington	38 53	77 00	37.3	—12	— 7	— 4	0	+ 8	—13	—24	—13
Sunbury	40 52	76 49	30.6	—22	...	—12	+ 2	+12	—17	—22	—15
Baltimore	39 18	76 37	35.0	—12	— 8	— 5	+ 2	+18	—12	—18	—13
Fort Monroe	37 00	76 18	43.1	— 9	— 7	0	+ 6	+13	—11	—18	—21
Syracuse	43 1	76 15	29.1	— 7	— 8	0	+14	+ 3	—18	—21	—19
Ellisburg	43 45	76 10	25.9	— 2	+ 3	— 1	+10	+10	—10	—13	—12
Gouverneur	44 25	75 35	20.0	— 6	+ 5	+ 3	+17	+ 6	— 9	—13	— 9
Utica	43 7	75 13	26.8	—17	— 6	—10	+ 8	+23	—14	—17	—18
Philadelphia	39 57	75 10	34.4	—14	— 9	— 9	+ 4	+22	— 9	—21	—23
Potsdam	44 40	75 1	22.1	...	...	...	...	+16	—10	—16	—12
New York	40 43	74 00	33.5	+ 8	— 5	— 4	+ 8	+20	— 6	—14	—14
Albany	42 40	73 45	28.4	—10	— 2	—12	+11	+24	—12	—14	—16
Montreal	45 31	73 35	18.6	+ 3	+ 5	+ 8	+16	+29	— 2	— 8	—10
Granville	43 20	73 17	24.8	— 5	+ 2	—10	+ 1	+20	—11	—11	— 1
New Haven	41 18	72 55	33.0	—14	—10	—15	+11	+22	— 2	—15	—16
Hanover	43 43	72 18	17.8	—11	— 3	— 9	+15	+26	+ 2	— 8	—13
Quebec	46 49	71 12	15.0	...	...	+10	+ 7	+25	+ 1	—11	...
Boston	42 21	71 3	30.3	— 6	— 2	— 3	+13	+20	— 2	—12	—13
New Bedford	41 38	70 55	32.3	— 7	— 5	— 4	+10	+16	— 2	—15	—16
East Hampton	41 00	70 19	33.4	— 9	— 6	— 9	+10	+19	+ 6	—15	— 5
Gardiner	44 10	69 50	25.3	—13	—10	— 9	+15	+20	+ 8	— 8	—15
Hancock Barracks	46 7	67 49	18.1	—10	— 1	—14	+ 1	+21	+17	— 8	—12
Halifax	44 39	63 37	27.7	— 6	— 6	— 8	+ 2	+ 9	+ 8	+ 4	—11
Bermuda	32 34	64 38	60.6	— 8	— 1	+ 3	+ 2	+ 3	+ 2	+ 3	— 2
St. Johns	47 34	52 38	25.3	+ 1	— 2	— 4	— 2	— 6	— 6	+ 6	+ 2

In accordance with the preceding numbers, the lines of equal thermometric disturbance have been drawn upon the five accompanying charts. On each chart is drawn the line of mean temperature, and on most of them are drawn lines of ten, twenty, and thirty degrees *below* the mean, as well as lines of ten, etc., degrees *above* the mean. On each of these maps, there appears a large area over which the

thermometer was above its mean height. For convenience we will call this area the area of *high thermometer*. On the evening of December 19th this area of high thermometer extended from 800 to 1,100 miles in an east and west direction; but at only three places did the thermometer rise as high as ten degrees above the mean. December 20th the area of high thermometer near the parallel of 40° had contracted to a breadth of 570 miles, and at several places the thermometer stood more than fifteen degrees above the mean. On the morning of the 21st the thermometer at several places stood more than twenty degrees above the mean. Thus it appears that near the centre of the storm the heat had increased about fifteen degrees in thirty-six hours, from the evening of the 19th to the morning of the 21st.

The centre of this area of high thermometer did not coincide with the centre of the area of low barometer, but was uniformly somewhat to the eastward of it. On the morning of December 20th, near the parallel of 40°, the point of greatest heat was considerably eastward of the centre of the area of rain and snow, and was about 400 miles east of the point of least barometric pressure. On the evening of December 20th, near the parallel of 44°, the point of greatest heat was about 350 miles east of the point of least pressure, and this last point coincided nearly with the centre of the area of rain and snow; while on the morning of December 21st, near the parallel of 46°, the point of greatest heat was about 200 miles east of the point of least pressure. On the eastern side of the storm, where the rain had not yet commenced, the thermometer stood twenty degrees above its mean height; while on the western margin of the storm the thermometer sunk below its mean height before the rain and snow had ceased. On the evening of December 21st the points of greatest heat and of least pressure probably differed but little in position.

Face of the Sky.

On the five accompanying charts, the face of the sky has been represented by colors in accordance with the original observations, of which the most important particulars are given in my article published in the *Transactions of the American Philosophical Society*, vol. vii. pp. 133–137. From these charts it will be seen that on the evening of December 19th rain or snow was falling throughout the entire region west of the Mississippi, as far as the map extends, and the cloud covered the entire United States, except those States bordering on the Atlantic Ocean. On the morning of the 20th the rain and snow had extended eastward as far as Cincinnati, and the cloud covered the entire United States, except New York and New England. On the evening of the 20th the rain had extended eastward to Washington, while only a small portion of New England was free from cloud. The boundary of the rain and snow on the west now comes within the limits of the chart, and an area of clear sky appears beyond Arkansas and Louisiana. On the morning of the 21st the cloud has covered the whole of the eastern portion of the chart, while the western portion is left unclouded as far as Cincinnati. The rain now covers the whole of New England, except the State of Maine, while the western boundary of the rain and snow has reached the middle of Lake Erie. On the

evening of the 21st the storm is confined to the eastern margin of the chart, while the western boundary of the rain has passed to the east side of the Connecticut river; and throughout the whole of the United States, except New England and two or three small spots of limited extent, the sky is entirely free from clouds.

Throughout the entire United States the average amount of rain which fell during this storm was seven-eighths of an inch, and although the fall at different places was very unequal, still the average amount was sensibly the same on the eastern as on the western part of the country, and on the north side nearly equal to that on the south side.

Direction of the Wind.

On the accompanying charts the direction of the wind has been indicated by arrows, according to the observations given in my first memoir, pp. 137–139. It will be seen that on the evening of the 19th, throughout the area of rain and snow as far as it is exhibited on the chart, the wind blew from the south or southeast. On the east side of the boundary of rain and snow, but within the limits of the cloud, the winds appear to be somewhat influenced by the storm; but in New England the winds blow from about their normal direction; that is, from the west, inclining somewhat to the northwest.

On the morning of the 20th, beyond the Mississippi river, the winds had changed to the north and northwest; but on the eastern half of the area of rain and snow the prevalent direction of the winds was from the southeast. For some distance beyond the boundary of the rain on the east, the winds inclined towards the southeast, while along the northeast border of the United States the winds were generally from the southwest; but they were light, and in some places changing to northeast.

On the evening of the 20th, beyond the meridian of Chicago, the winds everywhere blew from the north or northwest. Throughout all the remaining part of the United States, with here and there a solitary exception, the winds blew from some southern quarter, and the prevalent direction was from a point a few degrees east of south.

On the morning of the 21st, on the west side of the centre of the storm, the winds were generally from the west and northwest; the prevalent direction being from a point a few degrees north of west. On the east side of the centre of the storm, the winds were generally from the south and southeast, the prevalent direction being from a point a little east of south.

On the evening of the 21st, throughout the extreme western part of the United States, the winds were becoming less northerly than in the morning; but in the neighborhood of the storm, on the west side of its centre, the winds continue from the west and northwest; the prevalent direction being about thirty degrees north of west; while on the east side of the centre the winds are from the south and southeast.

It will thus be seen that during the entire period in question, within the area of rain and snow, the direction of the winds was quite uniform. In the rear of the

storm the winds blew from the west, northwest, or north; the average direction being thirty degrees north of west; and in the southwest part of the United States the winds were somewhat more northerly than in the northwest part of the country. In front of the storm the winds generally blew from some southerly point. The average direction was ten degrees east of south; and in the south part of the United States the winds were quite as much easterly as in the north part of the country.

We thus find that along a meridian line, for a distance of at least 1,200 miles, we have on the west side a violent current setting from a point thirty degrees north of west; and on the east side, in close proximity, we have also a strong current setting from a point ten degrees east of south. These two currents blew with great violence for at least forty-eight hours, in directions inclined to each other one hundred and thirty degrees. It must be remembered that our observations are confined to the southern half of this storm, and that in order to discover what law the winds observed, it is important to have observations from every side of the centre of the storm. The observations here presented indicate a decided crowding of the winds towards the centre of the storm, and also some tendency to circulate around the centre, in a direction contrary to the motion of the hands of a watch; but this storm was so much elongated that the direction of the winds cannot be even approximately represented by circles, whose centre is at the point of greatest barometric depression.

Origin of the Storm.

This storm probably commenced not far to the west of the Mississippi river, and its origin is to be ascribed to the high barometer prevailing along the eastern part of the United States. This high barometer caused the wind on the eastern side of the Mississippi river to flow westward. This easterly current was opposed by the normal west wind, which prevailed at places further west. The west wind flowed under the east wind, by which means the latter was lifted up above the earth's surface, and its vapor was condensed by the cold of elevation. This condensed vapor descended in the form of rain or snow, according to the temperature of the place. The heat liberated in the condensation of this vapor expanded the upper stratum of air, causing it to rise above its ordinary elevation, and thus to flow off above, causing a diminished pressure at the earth's surface, so that throughout the area of rain and snow the barometer fell below its mean height. This fall of the barometer increased the strength of the east wind which set in from the eastern part of the United States, and this being forced upward from the earth's surface by the west wind which prevailed on the western side of the storm, caused a still greater precipitation of moisture, which liberated a greater amount of heat, and increased still further the fall of the barometer. A portion of the air which flowed off above from the region of the storm spread eastward, and increased the pressure over the eastern portion of the United States, thus adding to the strength of the east wind which blew upon the eastern side of the storm.

The air which thus spread eastward in advance of the storm was heated by the

caloric liberated in the condensation of the vapor, and this probably occasioned the rise of the thermometer in front of the storm, which was particularly noticeable on the morning of the 21st.

From the evening of December 19th to the evening of the 21st the phenomena remained sensibly the same, except that the storm had drifted steadily eastward, being borne along by the strong west wind; and since this west wind was more violent than the southeast wind, the partial vacuum prevailing under the storm was gradually filling up, and after two or three days more it had nearly disappeared.

What was the Cause of the extreme Cold which succeeded this Storm?

On the morning of December 20th, near St. Louis, the thermometer stood at its mean height. At the same place, on the evening of the same day, the thermometer had fallen to thirty degrees *below the mean;* being a descent of thirty degrees in twelve hours, independent of the diurnal variation.

This cold cannot be ascribed to radiation, for the change took place under the cloud, and even before snow had entirely ceased falling. A portion of the effect may be ascribed to the transfer of air from a higher to a lower latitude. The wind had blown with a probable velocity of sixty miles per hour for twelve hours, during which time it must have advanced 720 miles towards the southeast, or about 500 miles in the direction of a meridian, which is equivalent to about seven degrees of latitude, and corresponds to a change of temperature of about eighteen degrees. But a portion of this cold would be lost during the transfer to a warmer latitude, so that we cannot ascribe to a change of latitude an effect greater than twelve or fifteen degrees.

This cold air being somewhat warmed during its progress southward, is thereby rendered relatively dryer; and this dryness accelerates the evaporation of the moisture upon the earth's surface. This evaporation begets cold on the evaporating surface; and this cold is shared in part by the air in contact with the earth's surface. This cause must tend in some degree to check the increase of temperature which the air would otherwise experience in its transfer to a warmer latitude; but I do not ascribe to this cause any powerful effect. There still remains to be accounted for a depression of the thermometer amounting to about fifteen degrees.

I believe that this cold current came from the upper stratum of the atmosphere; and that the upper part of the atmosphere, when brought down to the level of the sea, is generally colder than the average temperature of the earth's surface. According to the theory of Dalton, the atmosphere can only be in a state of equilibrium when a pound of air, at all distances above the earth's surface, contains the same quantity of heat. Under such circumstances, if air be brought down from the top of a mountain, by coming under increased pressure it must acquire exactly the temperature of the air which was previously at the base of the mountain. But such an equilibrium is seldom, if ever, attained in nature. The heat which is liberated during a great fall of rain or snow increases the temperature of the upper air; and if this air could be suddenly brought down to the earth's surface, it might

be found even warmer than the ordinary temperature of the earth's surface. But generally, under a clear and tranquil sky, the reverse must be true.

The atmosphere receives heat from the sun, and loses its heat by radiation. It is estimated that in clear weather the atmosphere absorbs only about one-fourth of the rays of the sun which traverse the atmosphere vertically. The remaining rays are received upon the earth's surface, by which the earth is heated, and this heat is thence communicated to the air which rests upon the earth. The heat which the atmosphere receives is, therefore, chiefly applied to its lower stratum. This heat is all lost by radiation; for otherwise the mean temperature of the earth would be continually increasing. The rate at which a hot body loses its heat by radiation, is proportional to the difference between its own temperature and that of the surrounding medium. Suppose, then, that a pound of air at the top and bottom of the atmosphere contained the same amount of heat, the upper atmosphere having on one side a void space whose temperature is many degrees below zero, would lose its heat much more rapidly than the lower portion of the atmosphere. The atmosphere, then, receives its heat chiefly at the bottom, and loses it most rapidly at the top. The top must, therefore, ordinarily be the coldest, and such would still be the case, though the atmosphere had throughout the same density. In a clear and tranquil time, a pound of air at the earth's surface must, therefore, contain more heat than a pound of air on the summit of a mountain; and if air from the summit of the mountain could be made suddenly to displace the air at the level of the sea, it would feel colder than the latter. Such a condition of the atmosphere is at best one of unstable equilibrium, and the lower strata tend continually to rise and take the place of the upper. Such a motion is indicated nearly every pleasant day, by the formation of cumulus clouds soon after the rising of the sun, and their disappearance on the approach of evening. More violent and extensive disturbances of this equilibrium take place in thunder-gusts and tornadoes, when large masses of air from the earth's surface are pressed upwards with great violence, and their place is occupied by air from the upper strata; and the uniform effect of such an interchange of air is a considerable reduction of temperature at the earth's surface. After a few days' continuance of pleasant weather, the lower air again becomes much warmer than the upper air, and another somerset takes place, accompanied by a like reduction of temperature.

EUROPEAN STORM OF DECEMBER 21–28, 1836.

Observations of the Barometer.

The following table presents a summary of the observations of the barometer at each of the European stations from which reports have been received. Column first shows the name of the station; columns second and third their latitude and longitude; and column fourth the mean height of the barometer at each station. The numbers in this column are in most cases derived from observations continued through a series of several years, and represent the mean height of the barometer

with tolerable accuracy; but at some of the stations the mean height of the barometer is only approximately determined. Columns five to twelve furnish the difference between the mean height of the barometer and the height observed at noon for each day from December 21st to December 28th. At some of the stations no observation was made precisely at noon, and in such cases the barometric fluctuation was computed by a comparison of the preceding and subsequent observations:—

STATIONS.	Latitude.	Longitude.	Mean height.	BAROMETRIC FLUCTUATIONS.							
				Dec. 21. Noon	Dec. 22. Noon.	Dec. 23. Noon.	Dec. 24 Noon.	Dec. 25. Noon.	Dec. 26. Noon.	Dec. 27. Noon.	Dec. 28 Noon.
			Inches.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
Upernivik	72° 48′	55° 53′W.	29.78	+.55	+.10	+.24	+.22	+.20	+.14	—.39	—.67
Reykiavig	64 8	21 55 W.	29.54	+.69	+1.13	+1.33	+1.12	+.92	+.67	+.63	+.48
St. Petersburg	59 56	30 18 E.	29.96	—.38	—.38	—.33	—.15	+.22	+.53	+.42	+.44
Christiania	59 54	10 44 E.	29.76	—.07	+.15	+.17	+.53	+.80	+.88	+.58	+.53
Sandwick	59 5	3 17 W.	29.46	+.26	+.16	+.24	+.64	+.74	+.62	+.62	+.62
Riga	56 57	24 6 E.	29.98	—.10	—.37	—.39	—.13	+.25	+.38	+.20	+.17
Catherinenburg	56 50	60 34 E.	29.03	—.41	—.43	—.35	—.50	—.63	—.26	+.05	+.15
Edinburgh	55 57	3 11 W.	29.64	+.33	+.36	+.19	+.31	+.39	+.39	+.22	+.36
Moscow	55 45	37 38 E.	29.22	—.38	—.54	—.80	—.55	—.11	+.23	+.22	+.12
Konigsberg	54 42	20 29 E.	29.90	+.05	—.14	—.63	—.06	+.24	+.15	—.02	+.04
Danzig	54 21	18 41 E.	29.95	+.22	+.08	—.49	+.10	+.31	+.25	+.25	+.15
Stralsund	54 19	13 5 E.	29.88	+.21	+.21	—.48	—.02	+.13	—.01	—.06	—.02
Altona	53 32	9 56 E.	29.87	+.16	+.08	—.36	—.15	—.06	—.20	—.15	—.04
Dublin	53 23	6 11 W.	29.73	+.44	+.50	+.23	+.19	+.28	+.15	+.06	+.29
Swislotsch	53 2	24 5 E.	29.06	+.21	—.35	—.50	—.28	—.13	—.05	+.04	+.04
Boston	52 48	0 5 E.	29.60	+.23	+.31	—.20	—.10	—.05	—.12	—.20	+.04
Berlin	52 30	13 24 E.	29.94	+.13	+.06	—.87	—.30	—.27	—.39	—.34	—.21
Thwaite	52 24	1 0 E.	29.80	+.55	+.62	+.07	+.05	+.07	—.06	.00	+.24
Harlem	52 23	4 39 E.	29.83	+.37	+.38	—.19	—.14	—.19	—.29	—.23	—.03
Warsaw	52 13	21 1 E.	29.53	+.17	—.12	—.78	—.13	+.04	—.11	—.22	—.08
Cambridge	52 13	0 6 E.	29.87	+.41	+.48	—.02	—.11	—.05	—.21	—.19	+.04
Oxford	51 45	1 16 W.	29.71	+.44	+.48	—.01	—.09	—.04	—.23	—.21	+.09
Koursk	51 44	36 11 E.	29.27	+.02	—.16	—.53	—.60	+.11	+.20	+.04	—.20
London	51 28	0 5 W.	29.83	+.45	+.49	—.02	—.10	—.10	—.27	—.21	+.06
Cologne	50 56	6 58 E.	29.80	...	+.35	—.23	—.31	—.40	—.45	—.27	—.27
Brussels	50 51	4 22 E	29.76	+.36	+.39	—.22	—.31	—.39	—.50	—.31	—.12
Neisse	50 28	17 20 E.	29.26	+.40	+.22	—.51	—.16	—.16	—.22	—.23	—.07
Prague	50 5	14 25 E.	29.22	+.39	+.29	—.50	—.26	—.45	—.53	—.32	—.19
Cracow	50 4	19 51 E.	29.24	+.20	—.05	—.65	—.31	—.33	—.47	—.42	—.28
Paris	48 50	2 20 E.	29.76	+.30	+.40	—.24	—.47	—.51	—.60	—.42	—.16
Vienna	48 12	16 23 E.	29.34	+.24	+.10	—.37	—.44	—.49	—.66	—.44	—.34
Munich	48 8	11 36 E.	28.28	+.20	+.15	—.41	—.72	—.87	—.92	—.58	—.49
Peissenberg	47 48	11 1 E.	26.66	+.19	+.18	—.34	—.69	—.81	—.86	—.53	—.47
Buda	47 29	19 3 E.	29.11	+.36	+.13	—.27	—.29	—.31	—.49	—.31	—.24
Zurich	47 23	8 32 E.	28.53	...	+.27	—.20	—.70	—.78	—.77	—.50	—.39
Geneva	46 12	6 10 E.	28.60	...	+.31	—.09	—.68	—.75	—.68	—.48	—.34
St. Bernard	45 50	6 6 E.	22.19	+.16	+.17	—.20	—.68	—.83	—.83	—.64	—.53
Milan	45 28	9 11 E.	29.64	+.17	+.08	—.33	—.72	—.97	—.92	—.60	—.49
Padua	45 24	11 52 E.	29.94	+.21	+.14	—.24	—.64	—.81	-1.01	—.58	—.42
Bologna	44 30	11 21 E.	29.71	+.23	+.15	—.22	—.62	—.85	—.84	—.56	—.43
Orange	44 7	5 50 E.	29.84	+.17	+.15	—.09	—.64	—.77	—.66	—.58	—.44
Florence	43 47	11 15 E.	29.75	+.16	+.10	—.13	—.61	—.84	—.74	—.52	—.47
Toulouse	43 36	1 28 E.	29.49	+.28	+.29	+.01	—.68	—.59	—.70	—.62	—.31
Marseilles	43 17	5 22 E.	29.81	+.23	+.19	—.06	—.60	—.77	—.60	—.60	—.43
Rome	41 54	12 25 E.	29.84	+.15	+.13	+.01	—.38	—.64	—.56	—.38	—.35
Naples	40 51	14 15 E.	29.44	+.09	+.18	+.05	—.24	—.41	—.49	—.29	—.24
Cadiz	36 32	6 18 W.	29.84	+.07	+.12	+.02	—.25	—.24	—.22	—.25	—.26

In accordance with the preceding numbers, the lines of equal barometric disturbance have been drawn upon the eight accompanying charts from December 21st to December 28th. On each chart is drawn the line of mean pressure; also the line of a quarter inch elevation *above* the mean, and one-half inch above the mean; and also the line of a quarter inch depression *below* the mean. On six of the charts is

drawn the line of a half inch depression below the mean, and on three of them the line of three-quarters of an inch below the mean.

On the 21st of December the barometer was above its mean height throughout the whole of Europe, except its northeastern portion, and here the greatest observed depression was .41 inch. On the 22d the depression of the barometer near the centre of Russia had increased to a half inch, and the area of low barometer had extended somewhat further towards the south. On the 23d the area of low barometer had extended so as to cover nearly the whole of Europe, comprehending the whole of France, and more than half of Italy; while the area of one-half inch depression below the mean formed an oval figure, whose longer diameter was 1,750 miles, and its shorter diameter over 500 miles. On the 24th the area of low barometer covered all of Europe, except its extreme northern portion, and there are two areas of one-half inch depression; one having its centre near Switzerland, and the other in Central Russia. The former area was an oval 870 miles long and 560 broad, while the latter was 1330 miles long and 520 broad. On the 25th the Swiss area of a half inch barometric depression had somewhat extended its limits, being now 980 miles long and 830 broad; while the Russian area had travelled towards the northeast, and had nearly reached the eastern limit of Europe. On the 26th the Swiss oval of one-half inch depression had increased still further in its dimensions, being now 1150 miles long and 930 broad; while the Russian oval of one-half inch depression had passed beyond the limits of Europe. On the 27th the Swiss oval had greatly contracted in its dimensions, being now only 890 miles long and 400 miles broad. On the 28th the area of one-half inch depression below the mean had almost entirely disappeared, and the area of one-quarter of an inch depression had contracted very much in its dimensions.

The Swiss area of low barometer on the 24th probably had a different origin from that of the low barometer which prevailed throughout Eastern Europe on the 23d. The latter travelled towards the northeast from December 23d to December 25th, at the rate of about 40 miles per hour. The former probably originated in Western Europe, and its centre remained nearly stationary for four entire days, viz, from noon of December 24th to noon of December 28th, and this centre was at no time more than 140 miles from Mount Blanc, in Switzerland, being uniformly a little south of that mountain peak.

Observations of the Thermometer.

The following table presents a summary of the observations of the thermometer at the several stations. Column first shows the names of the stations; columns second and third their latitude and longitude; and column fourth shows the mean temperature of each station for the month of December. The mean temperature at noon for the month of December was obtained by applying to the mean temperature of the month a correction deduced from hourly observations at numerous stations in Europe. The mean temperature at noon was subtracted from the observed temperature, and the remainders are given in columns five to twelve. These remainders, therefore, show the number of degrees by which the temperature

observed at noon of each day differed from the mean temperature of the station at that hour. At some of the stations no observations were made at noon, and in such cases the thermometric fluctuation was interpolated by a comparison of the preceding and subsequent observations:—

STATIONS.	Latitude.	Longitude.	Mean temp. of Dec.	THERMOMETRIC FLUCTUATIONS.							
				Dec. 21. Noon.	Dec. 22. Noon.	Dec. 23. Noon.	Dec. 24. Noon.	Dec. 25. Noon.	Dec. 26. Noon.	Dec. 27. Noon.	Dec. 28. Noon.
Reykiavig	64° 8′	21° 55′W.	29°.4	− 7°	−13°	−18°	− 7°	− 1°	+ 4°	+ 8°	+ 7°
Yarensk	62 10	49 7 E.	−1.2	+35	− 1	− 1	− 6	−26	−17	−13	−37
St. Petersburg	59 56	30 18 E.	21.6	+10	0	− 4	−22	−14	−16	−11	− 7
Christiania	59 54	10 44 E.	27.2	+ 1	−13	− 6	−19	−19	−17	−24	−11
Sandwick	59 5	3 17 W.	41.8	0	+ 3	−11	−12	−11	−12	−12	− 7
Riga	56 57	24 6 E.	27.5	+ 4	+ 1	−11	−13	−21	−20	−22	−23
Catherinenburg	56 50	60 35 E.	4.5	+12	+18	+16	+22	+12	−11	−27	−19
Edinburgh	55 57	3 11 W.	39.7	+ 6	+ 8	− 6	− 5	−11	− 9	− 6	− 9
Moscow	55 45	37 38 E.	17.1	+17	+12	− 3	− 8	− 7	−17	−22	−19
Konigsberg	54 42	20 29 E.	27.1	+11	+ 8	+ 2	− 7	− 9	−11	−14	−17
Danzig	54 21	18 41 E.	31.8	+ 8	+ 3	− 3	−11	−11	−14	−14	−14
Stralsund	54 19	13 5 E.	34.2	+ 7	+ 4	− 2	− 7	− 8	− 7	− 5	− 9
Altona	53 32	9 56 E.	39.3	+ 2	+ 1	− 9	−10	−15	−15	−17	−17
Dublin	53 23	6 11 W.	41.5	+ 5	+ 6	− 7	− 7	−10	−10	− 8	− 9
Swislotsch	53 2	24 5 E.	25.9	+14	+ 9	+ 5	− 8	−18	−10	− 6	−10
Boston	52 48	0 5 E.	39.9	− 1	0	− 3	− 8	−10	− 9	− 5	− 7
Berlin	52 30	13 24 E.	35.0	+ 5	+ 2	− 3	− 9	−14	−18	−17	− 6
Harlem	52 23	4 39 E.	38.2	+ 5	+ 8	+ 1	− 7	−10	−10	−15	− 8
Warsaw	52 13	21 1 E.	28.8	+ 8	+ 8	+ 6	−12	−13	−14	−13	−15
Cambridge	52 13	0 6 E.	39.7	+ 1	0	0	− 8	−12	− 8	− 7	− 7
Oxford	51 45	1 16 W.	39.3	+ 5	+ 2	− 2	− 7	−15	−11	− 6	− 8
Koursk	51 44	36 11 E.	18.9	+14	+11	+ 6	+13	−11	−11	−11	−11
London	51 28	0 5 W.	40.5	+ 5	+ 3	0	− 6	−12	−10	− 7	− 7
Cologne	50 56	6 58 E.	37.4	...	+10	+ 5	− 4	−13	−15	− 7	− 7
Brussels	50 51	4 22 E.	39.4	+ 3	+ 5	+ 1	−11	−17	−20	−19	−18
Neisse	50 28	17 20 E.	33.6	+ 2	+ 2	+ 6	− 7	−16	− 9	−12	−12
Prague	50 5	14 25 E.	33.5	+ 2	+ 6	+ 7	− 2	− 8	0	− 4	− 9
Cracow	50 4	19 51 E.	29.5	+ 3	+ 6	+ 8	− 1	− 9	0	− 6	− 7
Poltava	49 35	34 34 E.	22.8	+12	+ 5	+ 5	+ 9	− 4	− 4	− 4	− 4
Paris	48 50	2 20 E.	38.6	+ 7	+ 4	+ 2	− 8	−16	−17	−18	−18
Catherinoslov	48 28	35 5 E.	22.8	+ 7	0	+ 7	+15	+14	− 1	+ 5	+10
Vienna	48 12	16 23 E.	33.0	+ 2	+ 5	+ 7	− 6	− 1	+ 3	0	− 5
Munich	48 8	11 36 E.	34.9	− 7	− 1	0	−10	− 7	−11	−17	−14
Peissenberg	47 48	11 1 E.	31.1	− 3	− 2	− 4	− 9	−10	−14	−15	−16
Buda	47 29	19 3 E.	29.7	+ 3	+10	+ 6	0	+ 7	+11	+ 7	+ 5
Zurich	47 23	8 32 E.	33.2	...	0	+ 2	+ 1	− 4	− 6	−12	−10
Geneva	46 12	6 10 E.	34.9	...	− 1	0	− 2	− 4	−12	−17	−11
St. Bernard	45 50	6 6 E.	16.3	+11	+ 8	+ 9	− 1	+ 1	− 3	−16	− 8
Milan	45 28	9 11 E.	36.6	− 2	− 4	− 4	− 4	− 2	− 2	− 5	− 6
Padua	45 24	11 52 E.	38.4	0	− 3	− 7	+ 3	+12	+ 3	− 1	− 6
Bologna	44 30	11 21 E.	39.2	− 2	0	− 2	+ 7	+ 6	+ 2	− 6	− 9
Orange	44 7	5 50 E.	46.2	− 8	− 6	− 9	− 9	−14	−18	−20	−17
Florence	43 47	11 15 E.	45.5	− 1	− 4	−11	− 1	+ 4	− 6	−12	−10
Toulouse	43 36	1 28 E.	42.0	0	0	− 5	− 5	−14	−13	−12	−19
Marseilles	43 17	5 22 E.	47.1	− 4	− 5	− 7	− 5	−14	−18	−13	−16
Rome	41 54	12 25 E.	47.8	+ 3	− 2	− 7	+ 3	+ 3	− 6	− 5	− 2
Naples	40 51	14 15 E.	49.1	+ 2	+ 1	− 1	− 4	+ 3	− 7	− 3	− 5
Cadiz	36 32	6 18 W.	53.6	− 2	0	0	− 4	−10	− 8	− 8	− 8

In accordance with the preceding numbers, the lines of equal thermometric disturbance have been drawn upon the eight accompanying charts. On each chart is drawn the line of mean temperature. On seven of them is drawn the line of ten degrees *below* the mean; and on four of them is drawn the line of ten degrees *above* the mean. During most of the eight days, throughout the principal part of Europe, the thermometer was *below* its mean height; but on the 21st, throughout the whole of Europe, except the extreme northern and southern portions, the thermometer stood *above* its mean height. Throughout Central Europe the thermometer nowhere

rose so high as ten degrees above the mean; but throughout a considerable part of European Russia the thermometer stood more than ten degrees above its mean height, and at one station it rose thirty-five degrees above the mean. On the 22d and 23d the area of ten degrees above the mean had contracted considerably in its dimensions; while on the north of Europe the thermometer had fallen ten degrees below the mean. On the 24th the line of mean temperature had moved somewhat to the southward; while the area of ten degrees below the mean included Norway, Sweden, and a considerable part of Northern Russia. On the 25th, throughout the whole of Europe, except its southeastern portion, the thermometer was below its mean height; and throughout most of Europe the thermometer stood from ten to twenty degrees below the mean. On the 26th, 27th, and 28th the area of low thermometer was somewhat further extended, covering the whole of Europe, except a small portion on the southeast; while throughout the principal part of Europe the thermometer stood more than ten degrees below the mean.

It is remarkable that while in the neighborhood of Switzerland from the 24th to the 28th of December the barometer stood from a half inch to an inch below its mean height, the thermometer in the same vicinity from the 25th to the 28th was from ten to twenty degrees below its mean height; and on the 26th and 27th the region of greatest barometric depression coincided nearly with that of greatest thermometric depression, being exactly the reverse of what usually occurs in the storms of the United States.

Face of the Sky.

The following table shows for each of the stations the face of the sky; that is, it shows at what stations snow was falling, and where rain was falling; where it was cloudy, but without rain or snow; and also at what stations the sky was free from clouds:—

FACE OF THE SKY.

STATIONS.	Dec. 21. Noon.	Dec. 22. Noon.	Dec. 23. Noon.	Dec. 24. Noon.	Dec. 25. Noon.	Dec 26. Noon.	Dec. 27. Noon.	Dec. 28. Noon.
Reykiavig	Clear	Clear	Clear	Clear	Cloudy	Cloudy	Rain	Rain
Yarensk	Snow	Cloudy	Snow	Snow	Cloudy	Clear	Cloudy	Clear
St. Petersburg	Snow	Snow	Cloudy	Cloudy	Clear	Cloudy	Cloudy	Cloudy
Christiania	Cloudy	Cloudy	Cloudy	Clear	Clear	Clear	Clear	Snow
Sandwick	Clear	Rain	Snow	Snow	Clear	Clear	Cloudy	Clear
Catherinenburg	Cloudy	Snow	Snow	Snow	Snow	Cloudy	Cloudy	Cloudy
Edinburgh	Clear	Rain	Cloudy	Snow	Snow	Cloudy	Snow	Cloudy
Moscow	Cloudy	Snow	Snow	Snow	Cloudy	Cloudy	Cloudy	Cloudy
Danzig	Cloudy	Cloudy	Snow	Cloudy	Cloudy	Snow	Snow	Cloudy
Stralsund	Cloudy	Cloudy	Snow	Snow	Snow	Snow	Cloudy	Cloudy
Altona	Cloudy	Rain	Rain	Snow	Suow	Snow	Snow	Snow
Dublin	Cloudy	Cloudy	Clear	Snow	Snow	Cloudy	Sleet	Cloudy
Swislotsch	Rain	Rain	Snow	Cloudy	Cloudy	Snow	Snow	Cloudy
Boston	Fine	...	Fine	Snow	Snow	Snow	Cloudy	Snow
Berlin	Cloudy	Cloudy	Snow	Snow	Snow	Snow	Snow	Snow
Harlem	Cloudy	Cloudy	Rain	Snow	Cloudy	Cloudy	Snow	Snow
Warsaw	Rain	Rain	Rain	Cloudy	Snow	Snow	Snow	Cloudy
Oxford	Cloudy	Cloudy	Rain	Snow	Snow	Snow	Snow	Cloudy
Koursk	Cloudy	Rain	Snow	Cloudy	Snow	Snow	Cloudy	Clear
London	Cloudy	Cloudy	Rain	Snow	Snow	Snow	Snow	Cloudy
Cologne	Cloudy	Cloudy	Rain	Snow	Snow	Cloudy	Cloudy	Snow
Brussels	Cloudy	Cloudy	Rain	Snow	Snow	Snow	Snow	Snow
Neisse	Cloudy	Cloudy	Rain	Snow	Snow	Cloudy	Cloudy	Cloudy
Prague	Cloudy	Cloudy	Rain	Snow	Snow	Cloudy	Cloudy	Snow
Cracow	Rain	Cloudy	Rain	Snow	Cloudy	Cloudy	Snow	Cloudy
Poltava	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Snow	Snow	Cloudy
Paris	Cloudy	Fog	Rain	Snow	Snow	Snow	Cloudy	Snow
Catherinoslov	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Snow	Cloudy	Cloudy
Vienna	Cloudy	Cloudy	Cloudy	Snow	Rain	Rain	Cloudy	Cloudy
Munich	Cloudy	Cloudy	Cloudy	Snow	Cloudy	Snow	Cloudy	Cloudy
Peissenburg	Clear	Cloudy	Cloudy	Snow	Cloudy	Cloudy	Cloudy	Cloudy
Buda	Cloudy	Cloudy	Cloudy	Cloudy	Rain	Cloudy	Cloudy	Cloudy
Zurich	...	Cloudy	Cloudy	Snow	Snow	Snow	Cloudy	Cloudy
Geneva	...	Cloudy	Cloudy	Snow	Snow	Cloudy	Cloudy	Cloudy
St. Bernard	Clear	Clear	Cloudy	Snow	Snow	Cloudy	Cloudy	Cloudy
Milan	Clear	Clear	Cloudy	Rain	Rain	Cloudy	Cloudy	Cloudy
Padua	Clear	Clear	Cloudy	Rain	Rain	Cloudy	Cloudy	Cloudy
Bologna	Clear	Clear	Cloudy	Rain	Rain	Cloudy	Cloudy	Cloudy
Orange	Clear	Clear	Cloudy	Rain	Cloudy	Cloudy	Snow	Snow
Florence	Clear	Cloudy	Clear	Rain	Rain	Rain	Rain	Cloudy
Toulouse	Cloudy	Cloudy	Cloudy	Rain	Snow	Cloudy	Snow	Snow
Marseilles	Clear	Clear	Cloudy	Rain	Cloudy	Cloudy	Snow	Snow
Rome	Clear	Cloudy	Cloudy	Rain	Rain	Rain	Rain	Rain
Naples	Clear	Clear	Clear	Rain	Rain	Rain	Rain	Rain
Cadiz	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy

The preceding particulars have been represented by the aid of colors on the eight accompanying charts, in the manner already explained. By inspecting these charts it will be seen that from the 21st to the 28th of December, throughout nearly the whole of Europe, the sky was constantly covered with clouds. On the 21st there was a small region of unclouded sky on the northwestern part of Europe, and another on the extreme southern part. Throughout nearly the whole of Russia rain or snow was falling, but at a moderate rate; and throughout all the rest of Europe the sky was overcast, but without rain or snow.

On the 22d there still remained a small region of unclouded sky on both the northern and southern borders of Europe. The Russian area of rain and snow had moved somewhat to the southward; while a second area of rain covered most of England and Scotland, as also Holland and the North Sea. On the 23d these two regions of rain and snow had united; thus forming a continuous area of rain or snow, extending from Land's End to the Ural Mountains, a distance of at least 2,800 miles; but its average breadth from north to south did not exceed 500 miles.

At the same time snow was falling over a limited space about the Orkneys, on the north of Scotland.

On the 24th this long storm divided and formed two separate storms; while the eastern portion advanced towards the northeast; but the other storm now covered an area about 1,500 miles in diameter, its centre being over the eastern part of France. There is no longer any region of unclouded sky on the southern side of Europe, but only on the northern margin. On the 25th both storms occupied nearly the same position as on the preceding day. On the 26th the Russian storm had passed beyond the limits of Europe, or had disappeared entirely; while the great storm of Western Europe had broken up into three separate areas of rain or snow; and in the southern part of Russia there appeared a new area of snow.

On the 27th, between the parallels of 50 and 56 degrees, we find a continuous belt of snow extending from east to west a distance of 2,000 miles, and a somewhat smaller area of rain and snow on the south of Europe; while a new area of rain appears in the neighborhood of Iceland. On the 28th the phenomena are generally similar to those of the 27th; but the snow area of Central Europe is now only about 900 miles from east to west; while a fourth area of snow appears in Sweden. The storm-cloud may now be said to extend over the whole of Europe; but in many places this cloud was thin, and at three stations the sky was left entirely uncovered.

It is desirable to know, not merely at what places rain fell, but also the amount of rain at each locality. Unfortunately, in most of the meteorological journals, the amount of rain is not stated at all; or the total amount of rain for the month is given, without stating the amount for each day. The following table indicates all the stations at which there is given for each day the amount of rain or melted snow:—

AMOUNT OF RAIN OR MELTED SNOW IN INCHES.

STATIONS.	Dec. 21.	Dec. 22.	Dec. 23.	Dec. 24.	Dec. 25.	Dec. 26.	Dec. 27.	Dec. 28.	Total of 8 days.
	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
Reykiavig	...	...	...	...	...	...	0.45	0.42	0.87
St. Petersburg	0.06	0.01	...	...	...	...	...	...	0.07
Catherinenburg	...	0.01	0.01	0.01	0.06	0.01	...	...	0.10
Edinburgh	...	0.32	...	...	...	...	0.31	...	0.63
Boston	...	...	...	...	...	...	...	...	0.78
Warsaw	0.01	0.11	0.61	0.02	0.06	0.02	0.28	0.13	1.24
Oxford	0.04	...	0.02*	...	...	...	...	...	...
London	...	...	0.10*	...	...	...	...	...	...
Brussels	...	...	0.22	0.03	...	0.28	0.02	0.05	0.60
Neisse	...	...	...	0.44	...	...	...	...	0.44
Prague	...	...	0.04	0.12	...	...	...	0.06	0.22
St. Bernard	...	...	...	0.51	1.14	...	...	...	1.65
Padua	...	...	...	...	...	...	...	...	2.04
Orange	...	...	...	...	...	...	0.37	...	0.37
Florence	...	...	...	0.44	0.70	0.87	0.73	0.44	3.18
Marseilles	...	...	...	0.08	...	...	0.09	...	0.17
Rome	...	...	...	0.02	0.71	0.36	0.30	0.24	1.63

* Snow not measured.

From the preceding data we should infer that the greatest amount of precipitation was in the northern part of Italy; but this conclusion is rendered somewhat

doubtful by the evident unreliableness of some of the reports. At London, and also at Oxford, no rain is reported from the 23d of December to the end of the month, although this period embraced one of the most remarkable snow-storms ever experienced in England. During a violent snow-storm very little snow collects in an ordinary rain-gauge; and the observers at London and Oxford, and perhaps also at some other stations, appear to have taken no account of the moisture which was precipitated in the form of snow. The following particulars, collected from the columns of the *London Times* from December 27th to December 31st, will convey some idea of the violence of this storm in England:—

"At Brighton, early on the morning of Saturday, December 24th, there was a fall of snow, averaging a depth of six inches, and it continued falling at intervals throughout the day. About 5 P. M. it set in for a regular fall, which continued throughout the night. The snow fell incessantly all day Sunday, and continued without intermission till Monday night. The roads were rendered impassable, the snow being in some places five and six feet deep. On Sunday the mail-coach from Brighton to London had travelled about eight miles, when it fell into a drift of snow, and the coach could not be extricated. The guard proceeded with the mail-bags on horseback. At Lewes, after the storm, an immense avalanche of snow glided from the cliff hills, and entirely destroyed five houses, killing eight of the inmates.

"At Rochester the oldest inhabitants did not remember so heavy a fall of snow, which in some places was drifted at least forty feet.

"At Ipswich there was a light fall of snow on Friday night (December 23d), and in the morning the country was covered with it. A heavy fall of snow commenced about six o'clock on Monday, which in various situations drifted in ridges of one hundred feet wide by twelve and fourteen feet high.

"At Harwick the snow fell to ten and twelve feet in depth.

"At Hull the fall of hail and snow exceeded anything before witnessed for several years.

"At Newcastle the snow fell very heavy on Christmas day, and continued all night and Monday without intermission. The ground was covered in some places, even in town, twelve feet in depth.

"Between Wansford and Stamford, in the hollows of most of the roads, the depth of snow-drift was from twelve to twenty feet. In the high open roads there was no snow, it having been blown away by the wind.

"Between Leicester and Northampton, in some parts of the road, the snow had drifted to the depth of thirty, forty, and in some places fifty feet.

"In the neighborhood of Marlborough the drift had accumulated the snow in the hollows from twelve to sixteen feet in depth.

"Near Dorchester, where the snow had drifted, it was in some places five feet deep."

The editor of the *Times* remarks: "Never before within our recollection was the London mail stopped for a whole night at a few miles from London, and never before have we seen the intercourse between the southern shires of England and the metropolis interrupted for two whole days."

From the preceding statements it is extremely difficult to form any estimate of the *average* depth of the snow; but comparing the effects of this storm with those of the severest snow-storms in New England, we can scarcely estimate the amount of snow at less than two or three feet on a level; which, when melted, would furnish two or three inches of water. This would make the amount of moisture precipitated in the east of England about equal to that in the north of Italy.

Direction of the Wind.

The following table shows the direction of the wind at the several stations at noon of each day. The heavy-faced letters indicate strong winds. At about half of the stations the force of the wind was not particularly recorded:—

DIRECTION OF THE WIND.

STATIONS.	Dec. 21. Noon.	Dec. 22. Noon.	Dec. 23. Noon.	Dec. 24. Noon.	Dec. 25. Noon.	Dec. 26. Noon.	Dec. 27. Noon.	Dec. 28. Noon.
Reykiavig	N. E.	N. E.	N.	N. E.	N. E.	E.	E.	S.
Yarensk	S. W.	N. W.	N.	N.	N.	Calm	Calm	N.
St. Petersburg	S. W.	N. W.	N. W.	N. W.	N. W.	N. W.	S. W.	Calm
Christiania	...	N.	...	N.	N.	N.	N.	N.
Sandwick	S. W.	W.	N.	N. E.	E.	Calm	Calm	N.
Catherinenburg	**W.**	S. W.	S. E.	S.	S. E.	**W.**	W.	W.
Edinburgh	W.	W.	...	...	...	...	...	...
Moscow	S. W.	**S. W.**	N.	N.	W.	**N. W.**	Calm	Calm
Danzig	W.	N.	E. S. E.	E.	S. E.	**E.**	E.	E. S. E.
Stralsund	W. N. W.	N. W.	**E. S. E.**	**E.**	**E.**	**E.**	**E. S. E.**	E.
Altona	W.	W.	**N.**	**E.**	**N. E.**	N. E.	N. E.	E.
Dublin	W.	W.	N.	N.	N.	N. E.	N. E.	N. E.
Swislotsch	W.	N. W.	N. W.	N.	N. E.	N.	N.	N. E.
Bedford, Eng.	...	S. W.	N. W.	**N.**	**N. E.**	**E.**	N. E.	N.
Berlin	W.	N. W.	N. W.	N. E.	N. E.	N. E.	N. E.	E.
Harlem	W.	W. S. W.	N. N. W.	N. E.	E. N. E.	N. E.	N. E.	N. N. E.
Warsaw	W.	N. W.	S. W.	N. E.	**E.**	**E.**	**N. E.**	N. E.
Oxford	W.	S. W.	N.	**N. E.**	**N. E.**	**N. E.**	N. E.	N. E.
Koursk	Calm	S. E.	S. E.	S. W.	S. W.	S. E.	N. E.	N. E.
London	W.	W. S. W.	N.	**N.**	**N. E.**	**N. E.**	**N. E.**	N. E.
Cologne	...	S. W.	N. W.	N.	N.	N. E.	N. E.	N. E.
Brussels	S. W.	S. W.	N.	N. E.	N. E.	N. E.	N. E.	N. E.
Neisse	N. W.	N. W.	**S. W.**	**N. W.**	N. W.	N. W.	N. W.	N. W.
Prague	S. S. W.	N. W.	**W. S. W.**	**E.**	**E.**	E. N. E.	N.	N. N. W.
Cracow	N. W.	N. W.	**N. W.**	N. E.	**N. E.**	**N. E.**	N. E.	N. E.
Poltava	S. W.	Calm	S. W.	S. W.	E.	E.	N. E.	E.
Paris	W.	N. N. W.	N.	N. N. E.	N. N. E.	N. E.	E. N. E.	N.
Catherinoslov	S. W.	S. E.	Calm	S. E.	Calm	S. E.	S. E.	S. E.
Vienna	W. N. W.	W.	W.	N. E.	S. E.	E. S. E.	S.	E. N. E.
Munich	N. E.	S. W.	W. S. W.	N. E.	N. E.	W.	E.	Calm
Peissenburg	N.	W.	**W.**	**N. E.**	E.	E.	N. E.	N. E.
Buda	N. W.	N. W.	**W.**	N.	N.	**E.**	S.	N.
Zurich	...	N. N. W.	S. W.	N.	N. N. W.	N. N. W.	E.	N. W.
Geneva	...	N. E.	S. W.	...	S.	S.	S.	N.
St. Bernard	S. W.	N. E.	N. E.	S. W.	S. W.	N. E.	N. E.	S. W.
Milan	E.	W.	N. W.	E.	**S. E.**	S.	S. S. W.	S. W.
Padua	...	...	...	...	E.	W.	N.	...
Bologna	E.	W. N. W.	W.	**S. S. E.**	**E.**	**S. S. W.**	W.	W.
Orange	N.	N.	N.	...	N.	N.	N.	N.
Florence	N. E.	E.	E.	S.	S. E.	S. W.	W.	S. E.
Toulouse	N. W.	W. N. W.	W.	N. W.	**N. W.**	S. E.	N.	W. N. W.
Marseilles	N. W.	N. W.	**N. W.**	N. W.	**N. W.**	**N. W.**	N. E.	N. W.
Rome	N.	N.	N.	**S.**	**S.**	**S. W.**	S. W.	S. W.
Naples	E. N. E.	N. E.	S. S. W.	S. W.	S.	S. W.	W. S. W.	S. S. W.
Cadiz	E.	E.	N.	N.	N.	N.	N.	N.

On the eight accompanying charts arrows have been drawn, representing for each day the direction of the wind, according to the preceding table. It will be seen

that on the 21st the wind blew from the west or southwest throughout nearly every part of Europe, except near its southern border. In Italy, and even as far north as Munich, the prevalent direction was from the northeast, and in Southern France it was from the northwest. These winds throughout the whole of Europe coincide remarkably with the average direction of the winds for the month of December. We find, then, on the 21st no considerable disturbing force operating upon the wind in any part of Europe. There was a storm, indeed, prevailing in Russia; but the amount of vapor precipitated appears to have been small, unless near the extreme northeastern border of Europe.

On the 22d, over Great Britain, the prevalent winds are from the west; but over most of France, Germany, and the northern part of Russia, the prevalent wind is from the northwest. In Southern Russia the winds are from some southerly quarter. Here we see the first operation of a great disturbing force, which on the next day became more decided, viz., a cold current pressing down from the north over Sweden and Germany. The storm in Russia is now becoming more decided, and its influence upon the direction of the winds is seen in the south of Russia.

On the 23d, over the whole of Western Europe, and also in Northern Russia, the prevalent winds are from the north; in South Germany they are from the west or southwest; while in Italy the directions are very various. Here we see the further progress of the cold current from the north, sweeping over the whole of Western Europe, from Iceland and the Orkneys over Great Britain, France, and Spain, joining probably the trade-winds, and thus continuing on to the equator. In the neighborhood of the Russian storm, the winds deviate more from their mean direction, and exhibit a tendency inward towards the area of least pressure.

On the 24th, throughout all the northwest quarter of Europe, as well as throughout most of Germany, the prevalent direction of the wind was from the northeast; in the southern part of France it was from the northwest; and in Italy it was from the south. Here we see a decided tendency in the winds of Western Europe to circulate around a centre, and also to crowd inwards towards that centre. This centre was near Mont Blanc, which was also near the point of least barometric pressure. Nearly all these winds in Western Europe were strong winds, and in many places their force amounted to a gale. In Eastern Europe there is also some indication of a tendency to circulate around the point of least pressure in Russia; but on account of the small number of observations, this remark would not be entitled to much consideration, were it not for its close analogy with the phenomena of Western Europe.

On the 25th, throughout a circle of about 750 miles radius, there is the same tendency to circulate around a centre near Mont Blanc, with a more decided crowding inward of the winds towards the area of least pressure; and in Eastern Europe there is an apparent tendency to circulate around the point of barometric minimum in Russia; but on account of the small number of the observations this tendency is very imperfectly exhibited. In Western Europe the winds were almost everywhere strong winds, amounting in many places to a severe gale.

On the 26th the direction of the winds in Western Europe was nearly the same as on the 25th, and near the parallel of 50 degrees easterly winds now prevail as

far eastward as the Black Sea; but in Italy the winds are generally inclined to the southwest. We see the same tendency of the winds to crowd inward towards the area of least pressure, and also to circulate around the centre of this area; and these winds, especially over Great Britain, were generally strong and violent.

On the 27th, between the parallels of 49 and 55 degrees, east and northeast winds still prevail as far east as to Central Russia; but the winds are less violent than yesterday. There is still a tendency to circulate around a central point; but this centre appears to be somewhat east of Mont Blanc. In Italy the prevalent winds are from the west and southwest; while in Austria they are from the south.

On the 28th, between the parallels of 46 and 55 degrees, north and northeast winds prevail as far east as Russia, and there is still a marked tendency of the winds inward towards the point of barometric minimum, which point is now situated over Northern Italy.

Origin of the Storm.

This storm appears to have originated in Western Europe. On the 21st, throughout the whole of Europe, the winds everywhere blew nearly in their normal direction. It should be noticed, however, that in Iceland the barometer stood 0.69 inch above its mean height. On the 22d the barometer at Iceland stood 1.13 inch above its mean height; and along the northwest border of Europe the barometer was everywhere unusually high. This unusual pressure of the atmosphere caused the air to flow towards places where the pressure was less; that is, towards Central and Southern Europe. Here was the origin of the northerly wind, which was experienced in Norway and Germany on the 22d. This northerly wind was cold, and under its influence the thermometer sunk below its mean height. This cold northerly wind interfered with the progress of the westerly wind which prevailed over Great Britain, so that the west wind was forced upward and compelled to flow over the north wind. By being thus elevated, it was cooled and a portion of its vapor condensed; and this was probably the origin of the rain which fell in England and Scotland on the 22d.

On the 23d the barometer in Iceland stood 1.33 inch above its mean height, and the northerly current has now displaced the westerly one throughout the whole of Western Europe, viz., in Great Britain, Ireland, France, etc. The westerly wind which prevailed over Great Britain on the 22d is now lifted above the earth's surface, and exists simply as an upper current. Its vapor is condensed by the cold of elevation, and thus originated the rain which prevailed over France on the 23d.

On the 24th the barometer in Iceland still continued more than an inch above its mean height, and this dense atmospheric wave has made sensible progress eastward, so that now as far east as Sweden the barometer is much above its mean height. The pressure of the air towards Central and Southern Europe now becomes stronger than before, and the westerly wind from the Atlantic is everywhere lifted above the earth's surface, and prevails as an upper current, while its vapor is condensed by the cold of elevation. This northerly current brings with it a considerable reduction of temperature, and north of the parallel of 46° the moisture which is

precipitated descends in the form of snow. The heat liberated in the condensation of this vapor, expands the upper stratum of air, causing it to rise above its usual elevation, and thus to flow off above, causing a diminished pressure at the earth's surface, so that near the centre of the storm the barometer stood about three-fourths of an inch below its mean height. This point of least pressure was situated nearly over the Alps of Switzerland. The low state of the barometer in Switzerland caused the air to press inward from every point of the compass. It was quite impossible that the air should advance in straight lines towards the point of least pressure; but there was a general circulation of the air around the central point, with a crowding of the air inward towards the centre. The air thus accumulated over the area of least pressure must have risen from the earth's surface, and thus lifted still higher the westerly wind which formed the upper current, causing an increased precipitation, and consequently diminished pressure at the centre of the storm. As the wind which pressed down from the north crosses parallels of latitude whose diurnal motion eastward is greater than its own, it has a relative motion to the westward, and thus on the northern border of the storm the north wind becomes a northeast wind. For a like reason, on the southern border of the storm, the southerly wind becomes a southwest wind. Thus, the rotation of the wind takes place in a direction contrary to the motion of the hands of a watch.

A portion of the air which flowed off above from the region of low barometer probably spread northward, and increased the pressure in the north of Europe, thus adding new energy to what was doubtless the primary cause of the storm.

On the 25th, throughout the whole of Western Europe, the phenomena were nearly the same as on the 24th; but near the centre of the storm the barometer had fallen still lower, the depression now amounting to about one inch below the mean. On the north of Europe the high barometer still continues, and the line of one-half inch pressure above the mean has advanced steadily to the southward since the first commencement of the storm; so that while in North Italy the barometer is one inch *below* the mean, at Christiania, in Norway, it is four-fifths of an inch *above* the mean.

On the 26th, throughout Western Europe, the phenomena are nearly the same as yesterday; but the action of the wind appears to be less uniform, so that while in some places the rain and snow are more violent than yesterday, at other places they have ceased entirely.

On the 27th the phenomena continue quite similar to those of the 26th; but there is a general diminution in the violence of the storm, and the greatest depression of the barometer scarcely amounts to two-thirds of an inch. This diminution of violence is probably due to the general prevalence of the cold current from the north, and the diminution of the westerly wind from the ocean, which furnished most of the vapor of precipitation.

On the 28th we find the same causes operating with an energy still further impaired, and probably from the action of the same cause, viz., the failure of the upper current, which furnished the vapor of precipitation. After the 28th the operation of the same causes grew gradually feebler, until at length they disappeared entirely.

Comparison of the Lines of Barometric and Thermometric Oscillation.

It is very obvious from an inspection of the charts that the lines representing the fluctuations of the barometer are very unlike those which represent the fluctuations of the thermometer, and it is not easy to discover any connection between them. In the United States, while the barometer falls during a storm of rain or snow, it is common for the thermometer to rise, so that the area of low barometer corresponds nearly to that of high thermometer, and the lines of equal barometric disturbance bear a considerable resemblance to the lines of equal thermometric disturbance. But in the storm of December 25th, throughout nearly all of Western Europe, the thermometer was pretty uniformly depressed about ten degrees below its mean height; yet the barometer in Christiania stood four-fifths of an inch *above* its mean height, while in North Italy it was about one inch *below* its mean height. Hence, we infer that change of temperature (as shown at the earth's surface) is not one of the principal causes of the fluctuations of the barometer. While in North Italy the barometer sunk an inch below the mean, the thermometer at the earth's surface scarcely anywhere rose as much as five degrees above the mean. Yet heat is always liberated when vapor is condensed, and we must hence infer that this condensation took place at a considerable elevation above the earth's surface—at an elevation greater than that of St. Bernard, which is more than 8,000 feet above the sea; for at St. Bernard there was a great fall of snow, but no rise of the thermometer.

It is also evident that the cause which produced the fall of the barometer in Switzerland, operated at an elevation of more than 8,000 feet above the sea, for at St. Bernard the oscillation of the barometer was as great as it was at the level of the sea.

On the 21st of December, in Russia, the area over which the thermometer was ten degrees above the mean corresponded tolerably well with the area of snow and rain, but was a little displaced, overlapping on the southeast side, and falling short on the northwest side. A similar remark is applicable to December 22d.

On the 23d, throughout the whole of Europe, the area over which the thermometer stood above its mean height exhibited nearly the same form as the area of rain and snow, but was displaced towards the south, overlapping on the south side and falling short on the north side. A similar remark is applicable to the 24th, at least as far as respects the Russian part of the storm.

The following is my explanation of these facts: In a great storm of rain and snow, when vapor is condensed, heat is liberated, which raises the temperature of the surrounding air above its mean height. This heated air is frequently wafted off by an upper current, and the heat of the upper stratum is partially communicated to the lower stratum, so that the area of high thermometer no longer corresponds with the area of rain and snow. The displacement of the one surface, as compared with the other, indicates the direction of this controlling upper current. From the 21st to the 24th of December, 1836, this upper current in Europe appears to have been from the northwest.

The fall of the Barometer in Great Storms is not the effect of Centrifugal Force.

Some persons have imagined the fall of the barometer in a storm to be due to centrifugal force. They say "the atmosphere constituting the body of the storm is driven outward from the centre towards the margin, just as water in a pail which is made to revolve rapidly flies from the centre and swells up the sides." But according to the principles of mechanics, the centrifugal force of a body revolving in a circle is to its weight as V^2 to $32\ R$, where V represents the velocity in feet per second, and R is the radius of the circle expressed in feet. Now, on the 25th of December the barometer fell half an inch below its mean height throughout a circle whose radius was 400 miles. We will estimate the velocity of the wind at 70 miles per hour, or 100 feet per second. Then

$$C : W :: 10000 : 32 \times 400 \times 5280$$
$$\text{or } C : W :: 1 : 6758;$$

that is, the centrifugal force is less than $\frac{1}{6000}$ part of the weight of the revolving body—a force which would depress the barometer less than $\frac{1}{2000}$ of an inch, whereas the barometer actually fell a half inch below its mean height; in other words, the centrifugal force generated by the rotation of the wind had no appreciable influence on the state of the barometer.

Supposed connection between the American and European Storms.

The European storm of December 25, 1836, was entirely independent of the American storm of December 20th. The rate of progress of the American storm of December 20th was such that it could not have reached England before the 27th; whereas the European storm had become fully organized on the 23d, and the first movement of the storm can be distinctly traced in Germany on the 22d. The European storm evidently originated in Europe; and the American storm gradually wasted away, and probably could not be traced beyond the middle of the Atlantic.

Generalizations.

By comparing the European storm of December 25, 1836, with the American storm of December 20, 1836, and also the storms of February 4 and 16, 1842, of which I have published an investigation in the *Transactions of the American Philosophical Society*, vol. ix. pp. 161–184, we are led to the following generalizations. Some of these conclusions are substantially the same as given by Mr. Espy, in his Fourth Meteorological Report; but several of Mr. Espy's conclusions are only true when applied to American storms.

1. The area covered by a violent storm of rain or snow is sometimes nearly circular in form; sometimes its form is very much elongated or elliptical, its length being two or three times its breadth; and frequently its form is very irregular. In

the winter storms of the United States, the north and south diameter is generally very much greater than the east and west diameter.

2. When storms are circular in form, the area of rain or snow is sometimes 1,500 miles in diameter; when their form is elliptical, the area of rain or snow is sometimes 1,000 miles wide, and 2,000 or 3,000 miles long.

3. Violent storms sometimes remain sensibly stationary for four or five days; but generally the centre of a storm has a progressive movement along the earth's surface. The rate of this progress has been observed to vary from zero to 44 miles per hour. From our limited number of observations, it seems probable that American storms travel more rapidly than European storms.

4. Within the limits of prevalent westerly winds, when violent storms advance with considerable rapidity, the direction of progress is always from west to east. This direction is not absolutely uniform, but has been observed to vary from about due east to N. 54° E.

5. Great storms of rain and snow are accompanied by a depression of the barometer near the centre of the storm, and a rise of the barometer near the margin; but this rise is not generally uniform along the entire margin.

6. The depression of the barometer at the centre of a storm sometimes amounts to more than an inch *below* the mean height; and the rise along some portion of the margin sometimes amounts to more than an inch *above* the mean height.

7. Winter storms commence gradually, and generally attain their greatest violence only after a lapse of several days; after a time their violence gradually diminishes, and at length they disappear entirely. This succession of changes requires a period of several days, sometimes one or two weeks, and possibly even longer. Sometimes all these changes are experienced over the same country; that is, the storm makes no progress from place to place. More commonly, however, the storm travels along the earth's surface; and although the same storm may continue for one or two weeks, or even longer, its duration at any one place may not exceed one or two days.

8. For several hundred miles on each side of the centre of a violent storm, the wind inclines inwards towards the area of least pressure, and at the same time circulates around the centre in a direction contrary to the motion of the hands of a watch.

9. In Europe, as well as in the United States, on the north side of a great storm the prevalent winds are from the northeast, while on the south side they are from the southwest.

10. The force of the wind is proportional to the magnitude and suddenness of the depression of the barometer; but very near the centre of a violent storm there is often a calm.

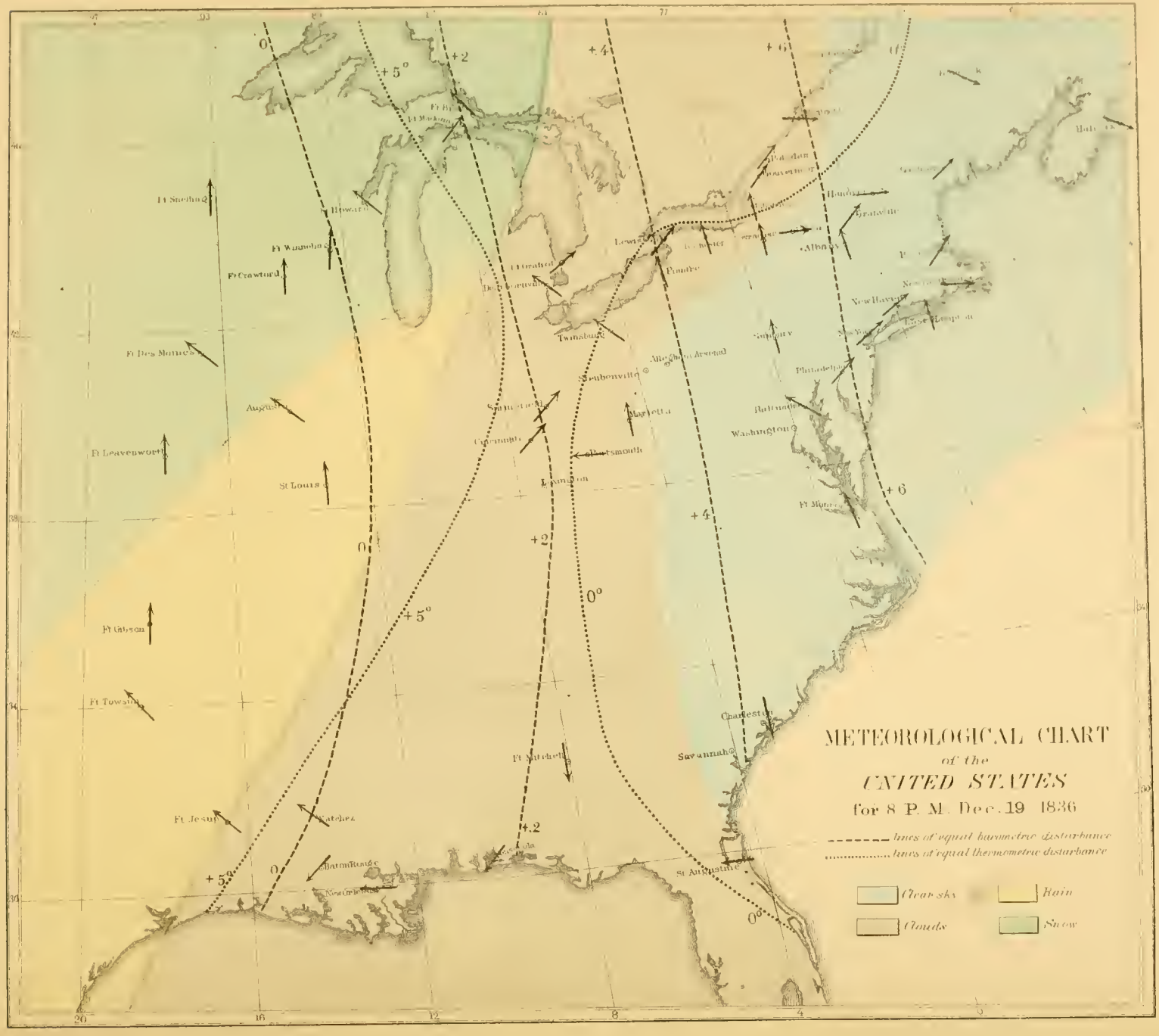
11. On the borders of the storm, near the line of maximum pressure, the wind has but little force, and tends outwards from the line of greatest pressure.

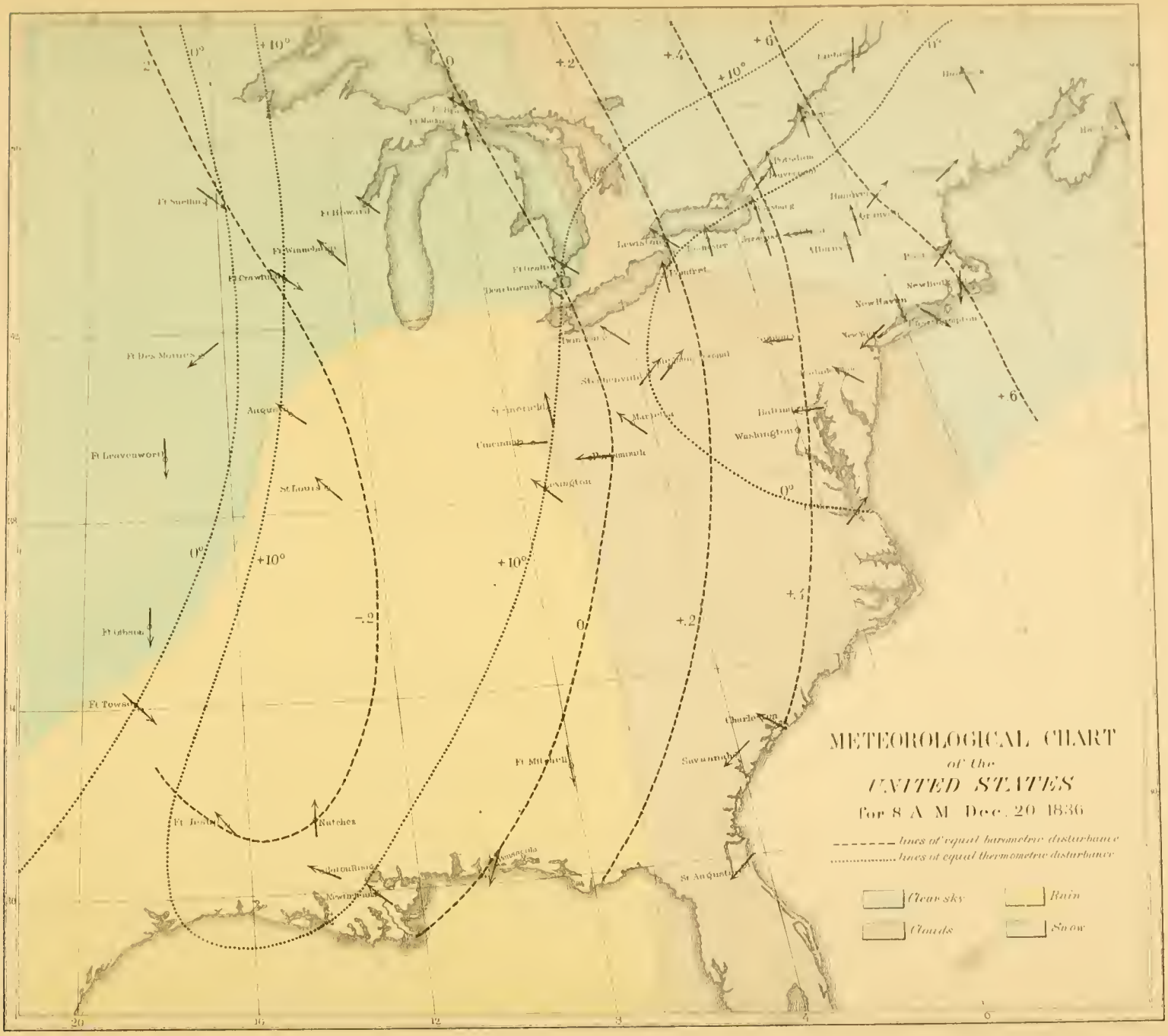
12. The wind uniformly tends from an area of high barometer towards an area of low barometer; and this is probably the most important law regulating the movement of the wind.

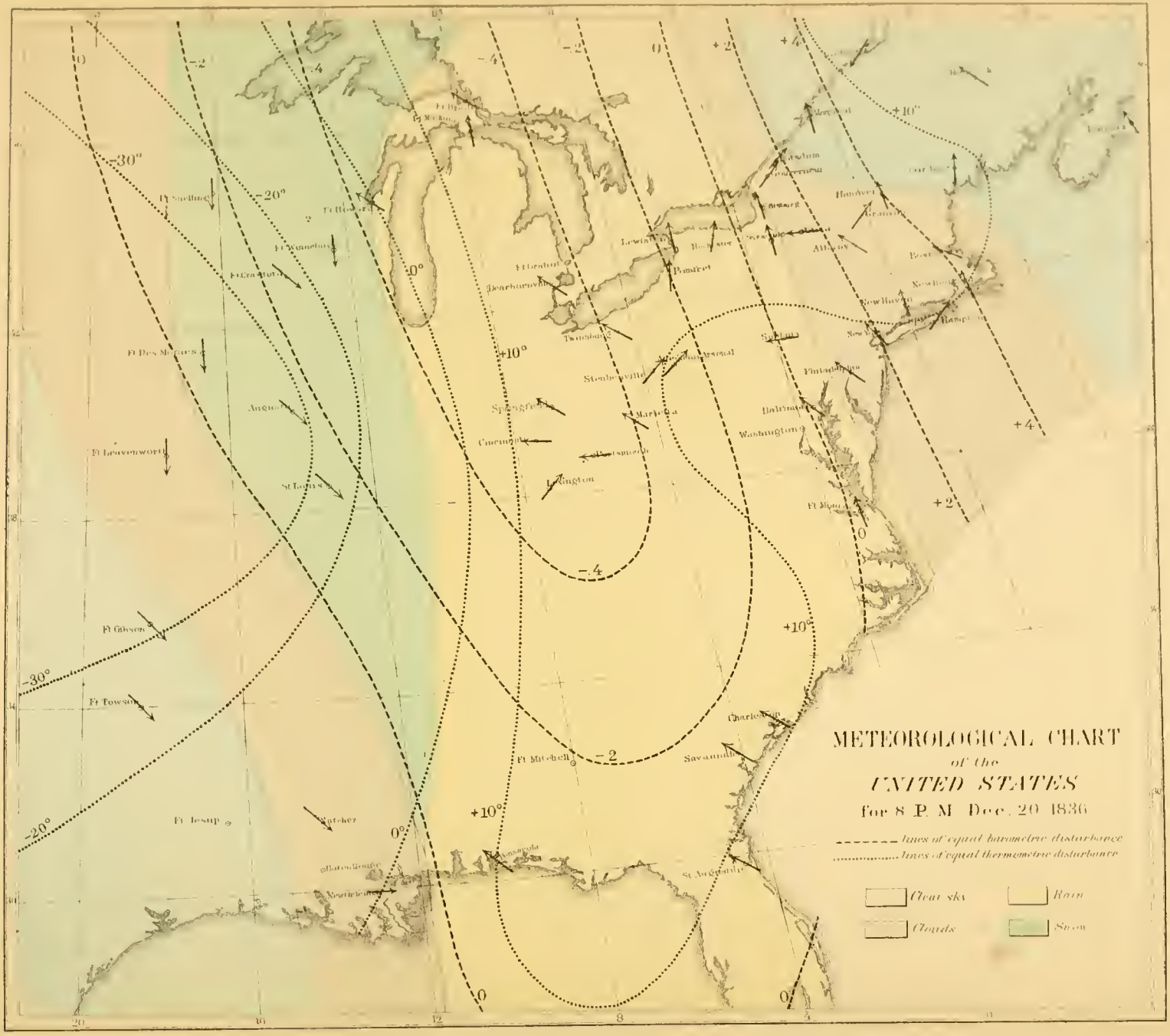
13. In a great storm, the centre of the area of high thermometer frequently does

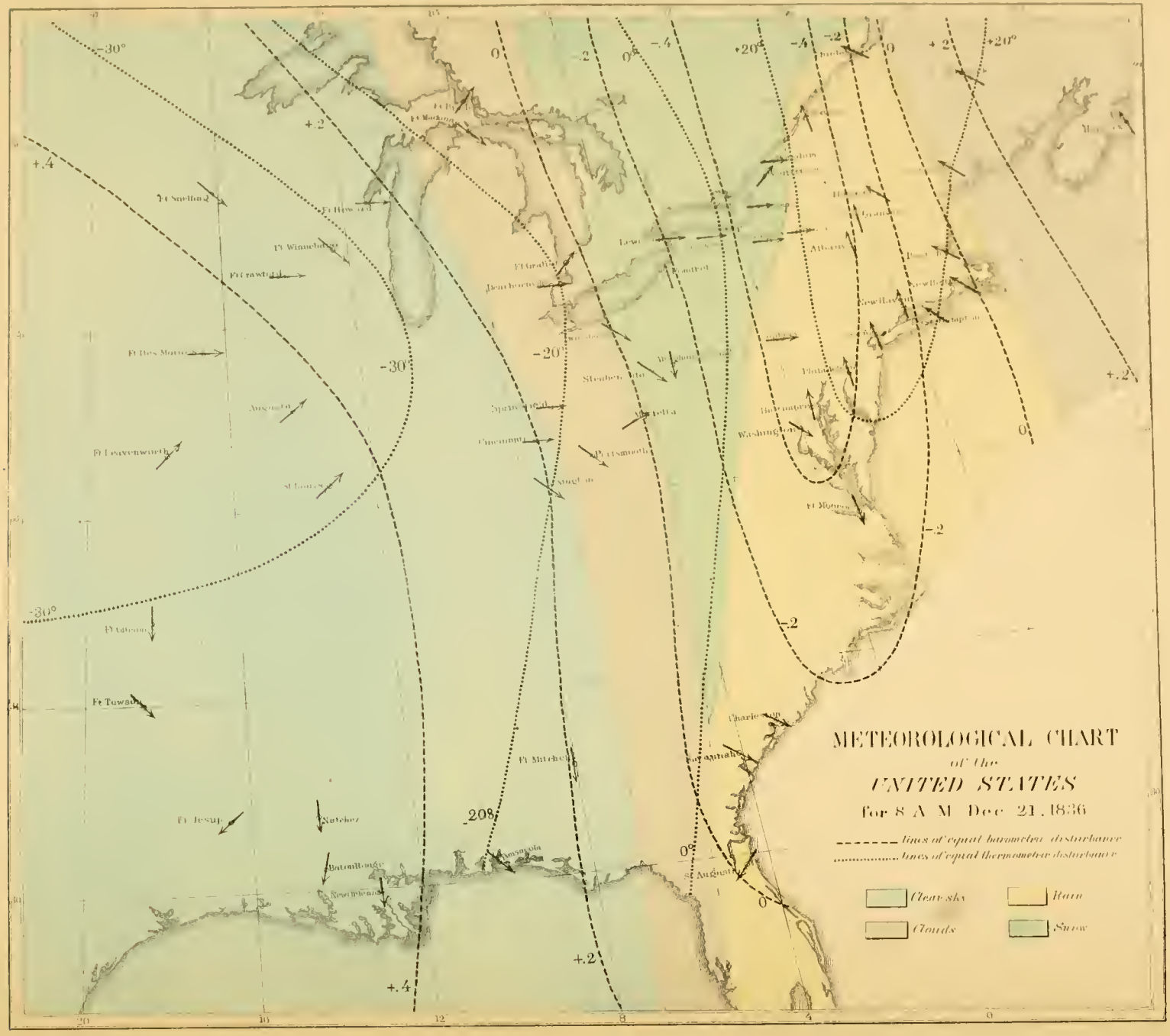
not coincide with that of the area of low barometer, or with the centre of the area of rain and snow. In the United States, on the northeast side of a storm, at a distance of over 500 miles from the area of rain and snow, the thermometer sometimes rises even twenty degrees above its mean height.

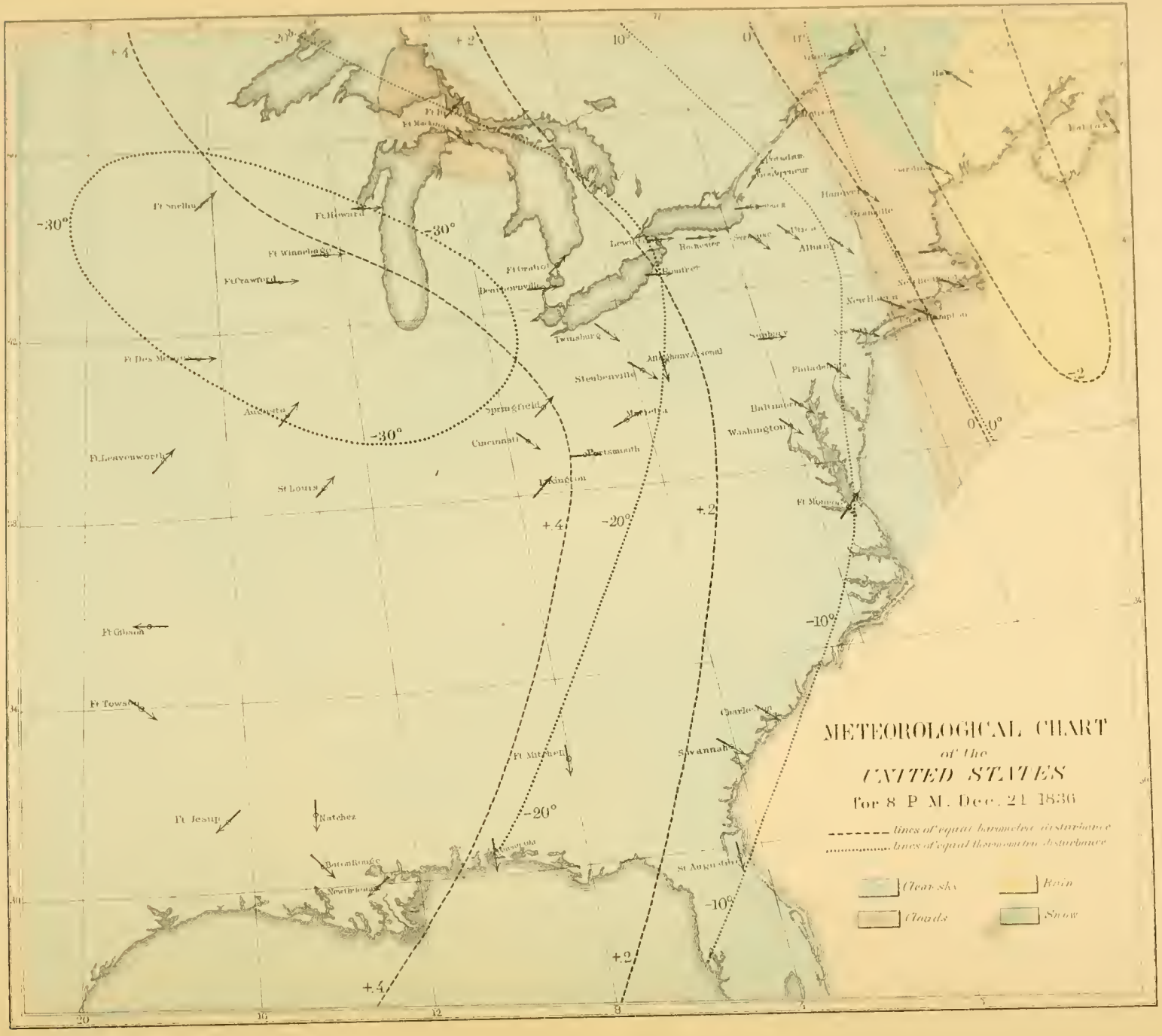
14. The storms of Europe are very much modified, and sometimes in a great measure controlled by the Alps of Switzerland. By the interposition of these mountains the air which sweeps over them is forced up to a great height, where it is suddenly cooled; its vapor is condensed; heat is accordingly liberated, by which the surrounding air is expanded, and rises above the usual limit of the atmosphere. It thence flows off laterally, leaving a diminished pressure beneath the cloud; that is, the barometer shows a diminished pressure in the neighborhood of the mountain. The mountain thus becomes the centre of a great storm, and the storm may continue stationary for several days, being apparently held in its place by the action of the mountain.

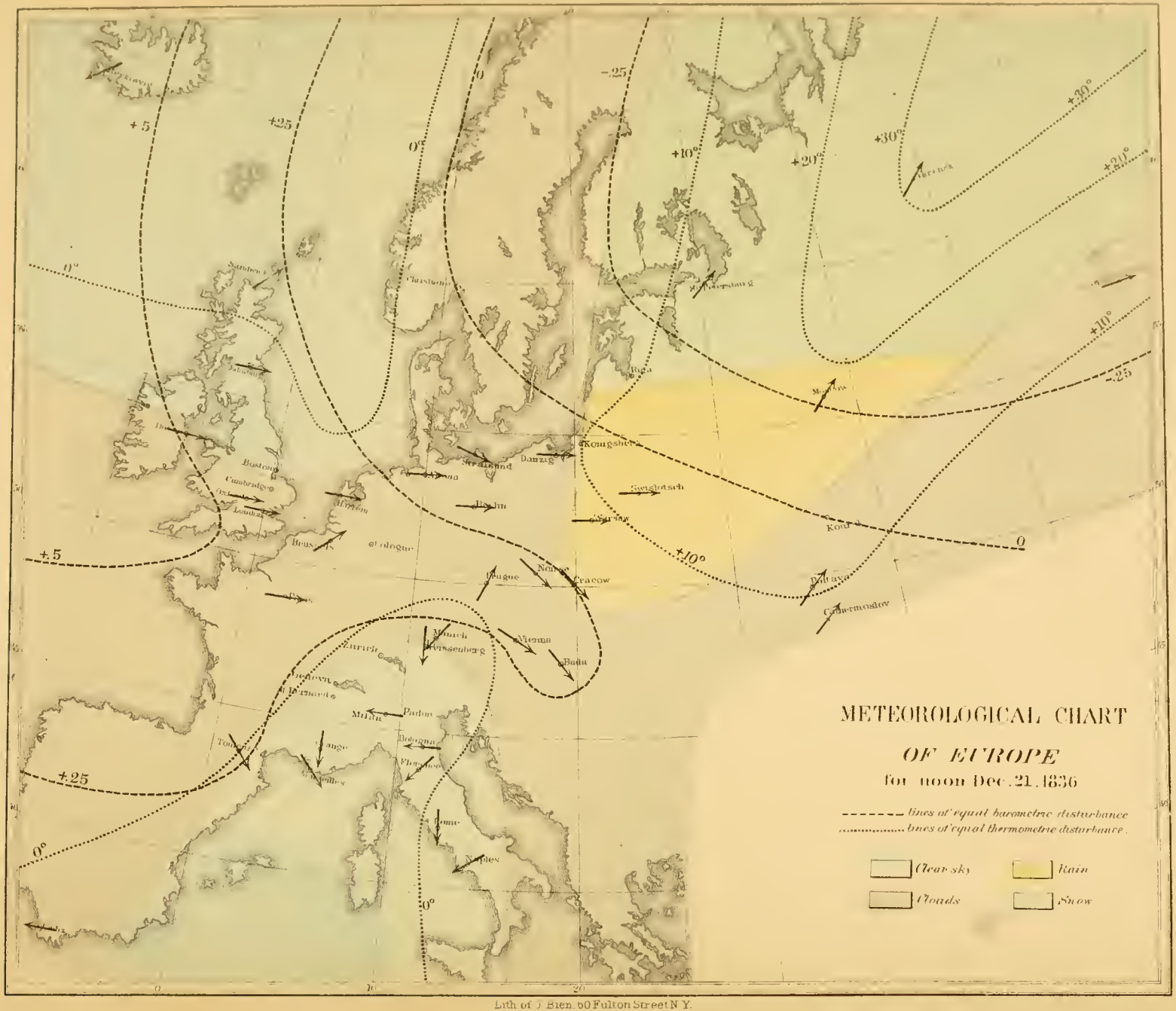

METEOROLOGICAL CHART
of the
UNITED STATES
for 8 P. M. Dec. 19 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
+5°
+2
+4
+6
0°
Ft Snelling
Ft Crawford
Ft Des Moines
Ft Leavenworth
St Louis
Ft Gibson
Ft Towson
Ft Jesup
Natchez
Baton Rouge
New Orleans
Ft Mitchell
Savannah
Charleston
St Augustine
Pittsburg
Steubenville
Washington
Baltimore
Philadelphia
Pittsfield
Albany
Hartford
Portsmouth
Lexington
Cincinnati
Zanesville
Marietta
Twinsburg
Howard
Ft Winnebago
Ft Brady
Ft Mackinac
Detroit
Pinedre
Lewiston
Batavia
Rochester
Utica
Albion
Schenectady
Troy
New Haven
Hartford
Providence
Boston
Portland
Halifax
Ft Monroe


METEOROLOGICAL CHART
of the
UNITED STATES
for 8 A M Dec. 20 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
+10°
0°
+6
+4
+2
Ft Snelling
Ft Howard
Ft Winnebago
Ft Crawford
Ft Des Moines
Ft Leavenworth
Ft Gibson
Ft Towson
Ft Jesup
Natchez
Ft Mitchell
Savannah
Charleston
St Augustine
Baltimore
Washington
New Haven
Albany
Hartford
Lexington
Cincinnati
St Louis
Augusta


METEOROLOGICAL CHART
of the
UNITED STATES
for 8 P. M. Dec. 20 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
Ft Snelling
Ft Des Moines
Ft Leavenworth
Ft Gibson
Ft Towson
Ft Jesup
Ft Mitchell
Ft Wayne
Ft Gratiot
Ft Dearborn
Ft Mackinac
Ft Howard
Ft Crawford
Augusta
St Louis
Springfield
Cincinnati
Lexington
Marietta
Steubenville
Pittsburg
Baltimore
Washington
Philadelphia
New York
New Haven
Boston
Portland
Albany
Hartford
Lewiston
Rochester
Pittsford
Batavia
Buffalo
Detroit
Monroe
Toledo
Sandusky
Cleveland
Columbus
Zanesville
Wheeling
Charleston
Savannah
St Augustine
Tallahassee
Pensacola
Natchez
Vicksburg
Little Rock
Nashville
Knoxville
Huntsville
Milledgeville
Augusta
Raleigh
Fayetteville
Newbern
Wilmington
Norfolk
Richmond
Petersburg
Lynchburg
Frederick
Harrisburg
Lancaster
Reading
Easton
Trenton
Burlington
Bordentown
Newark
Jersey City
Elizabethtown
Paterson
Hackensack
Morristown
Somerville
Flemington
Princeton
New Brunswick
Perth Amboy
Bridgeton
Salem
Woodbury
Camden
Mount Holly
Freehold
Jamesburg
Middletown
Port Jervis
Goshen
Newburgh
Poughkeepsie
Hudson
Albany
Troy
Schenectady
Utica
Rome
Syracuse
Auburn
Canandaigua
Geneva
Ithaca
Owego
Binghamton
Oswego
Sackets Harbor
Watertown
Ogdensburgh
Plattsburgh
Burlington
Montpelier
Windsor
Brattleboro
Bellows Falls
Keene
Concord
Portsmouth
Exeter
Dover
Portland
Augusta
Hallowell
Bangor
Machias
Eastport
St Andrews
St Johns
Fredericton
Woodstock
Houlton
Presque Isle
Caribou
Fort Fairfield
Fort Kent
Madawaska
Temiscouata
Rimouski
Metis
Cacouna
Kamouraska
Riviere du Loup
Isle Verte
Trois Pistoles
Rivière Ouelle
Kamouraska
St Roch
St Thomas
St Jean Port Joli
St Michel
St Vallier
St Henri
St Nicholas
Point Levi
Quebec
Beauport
Chateau Richer
Ste Anne
St Joachim
Cap Tourmente
Ste Famille
St Pierre
St Laurent
St Jean
St Francois
St Gervais
St Etienne
St Joseph
St Charles
St Croix
Lotbiniere
Deschambault
Portneuf
Pointe aux Trembles
Montreal
Chambly
St Johns
Laprairie
Beauharnois
Coteau du Lac
Cornwall
Williamstown
Lancaster
Alexandria
Hawkesbury
Grenville
Carillon
Lachute
St Andrews
Vaudreuil
Rigaud
Hudson
Como
Ste Anne
Ste Genevieve
Isle Perrot


METEOROLOGICAL CHART
of the
UNITED STATES
For 8 A M Dec 21. 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
-30°
-20°
+20°
+.4
+.2
0°
-.2
-.4
Ft Snelling
Ft Howard
Ft Winnebago
Ft Crawford
Ft Des Moines
Ft Leavenworth
Ft Gibson
Ft Towson
Ft Jesup
Natchez
Ft Mitchell
Ft Morgan
Ft Monroe
Washington
Philadelphia
Albany
Boston
Charleston
Savannah
St Augustine
New Orleans
Mobile
Tallahassee
208
20
16
12
8
4
0


METEOROLOGICAL CHART
of the
UNITED STATES
for 8 P M. Dec. 21 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
Ft Snelling
Ft Howard
Ft Winnebago
Ft Crawford
Ft Des Moines
Augusta
Ft Leavenworth
St Louis
Ft Gibson
Ft Towson
Ft Jesup
Natchez
Baton Rouge
New Orleans
Ft Mitchell
Cincinnati
Springfield
Lexington
Portsmouth
Steubenville
Zanesville
Wheeling
Twinsburg
Ft Gratiot
Detroit
Ft Mackinac
Lewiston
Rochester
Albany
Boston
Portland
Hallowell
Augusta
Hanover
Montpelier
Burlington
Plattsburg
Schenectady
Utica
Pittsburg
Philadelphia
Baltimore
Washington
Ft Monroe
Charleston
Savannah
St Augustine
+4
+2
0°
-10°
-20°
-30°



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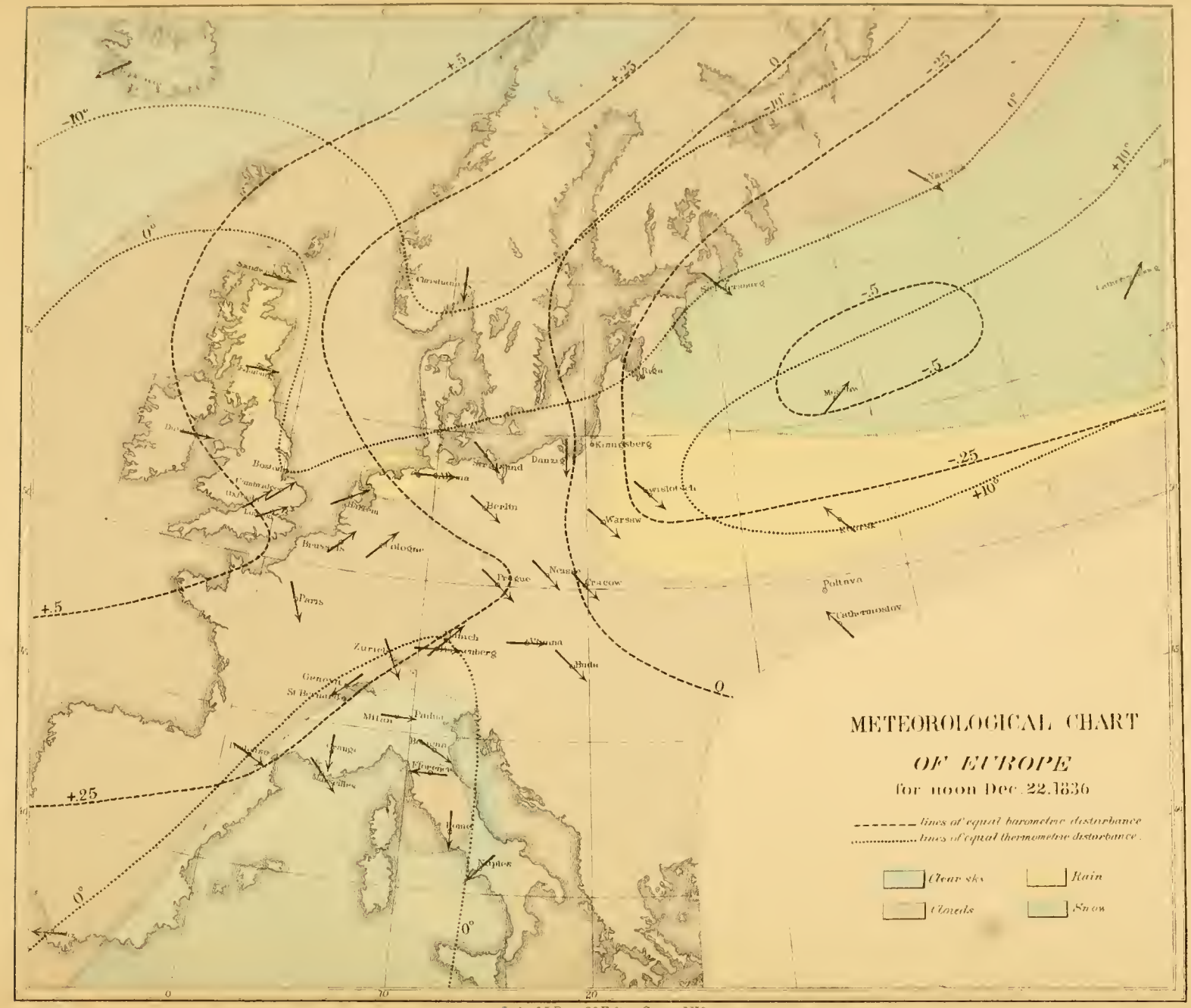
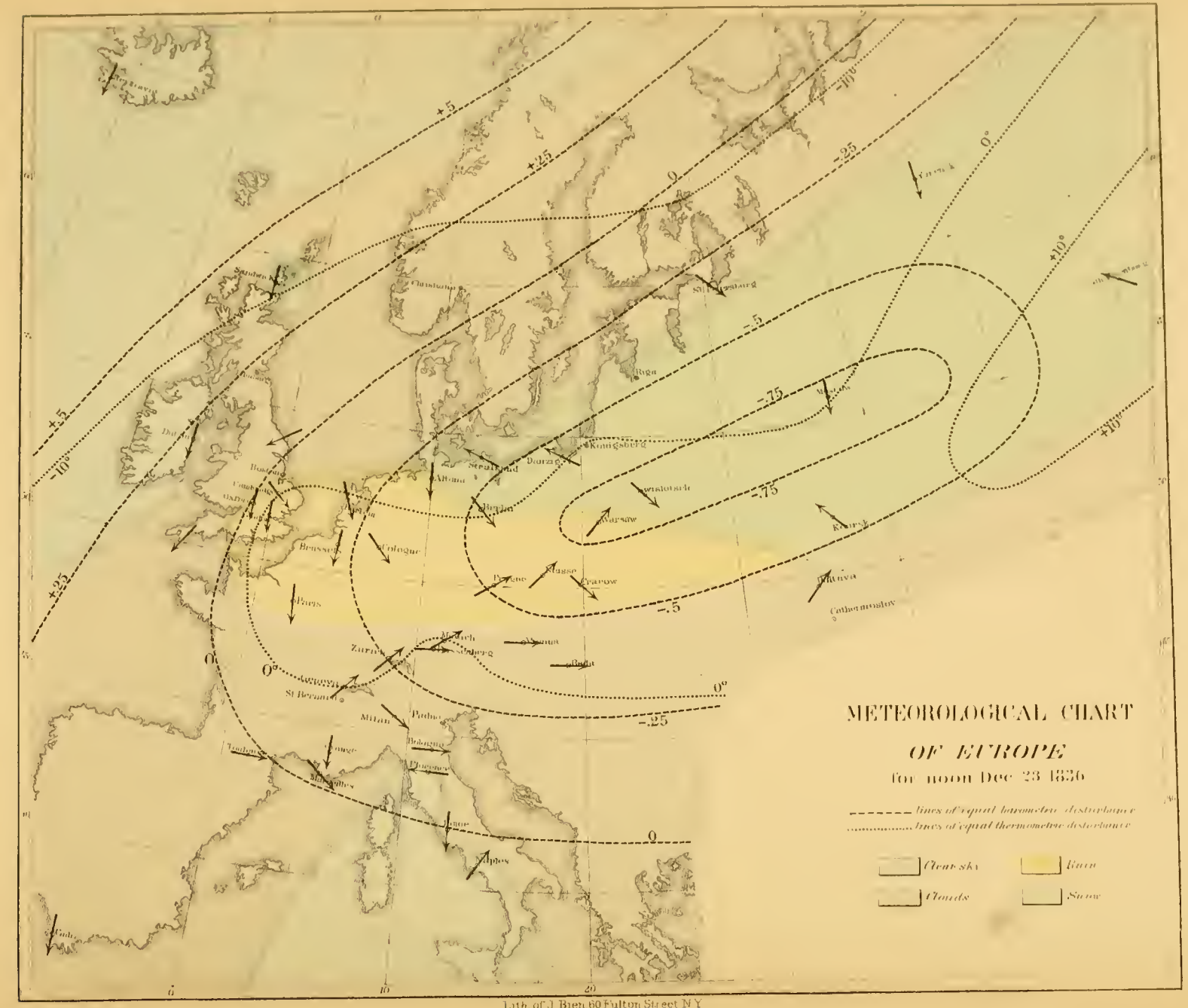
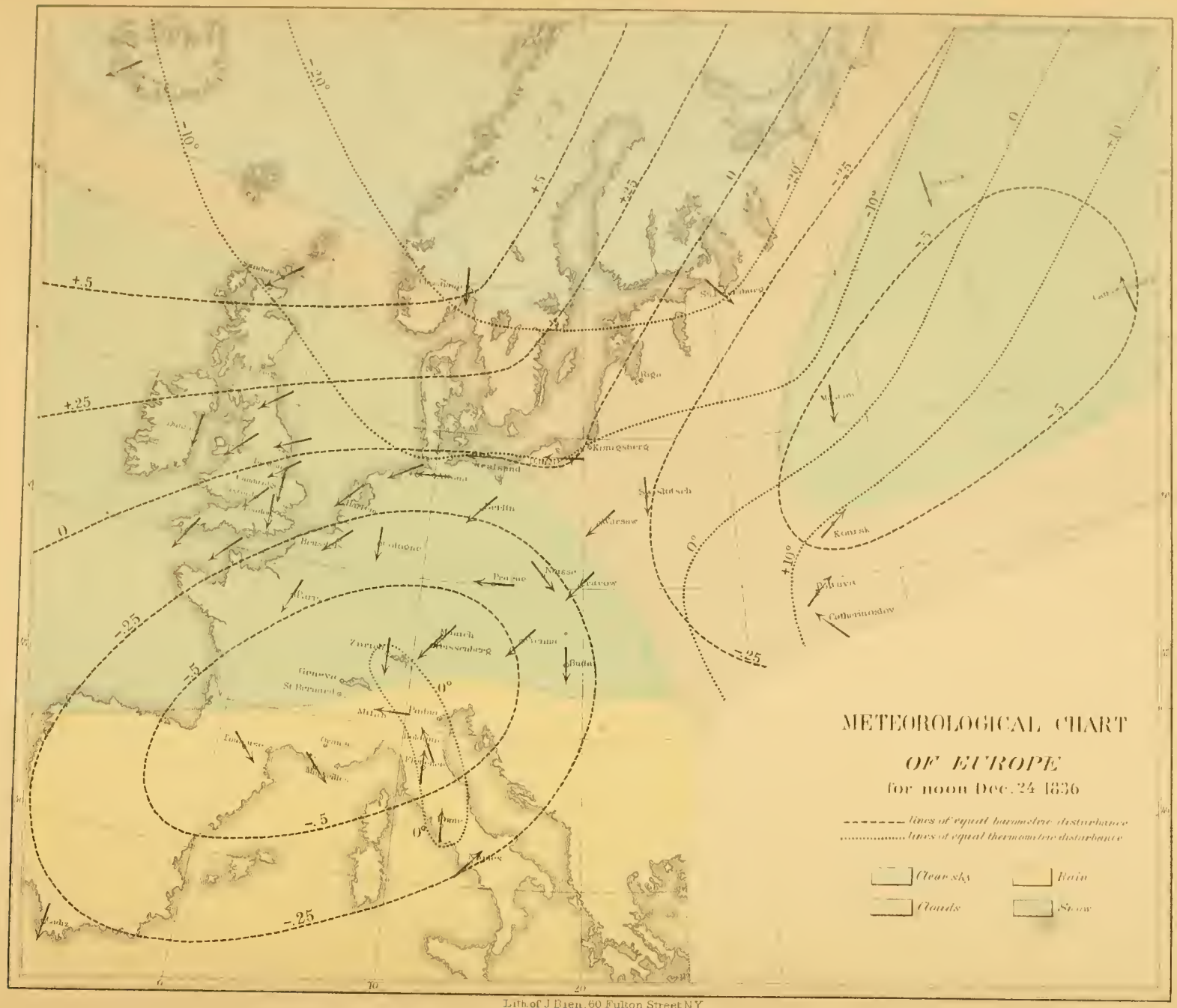
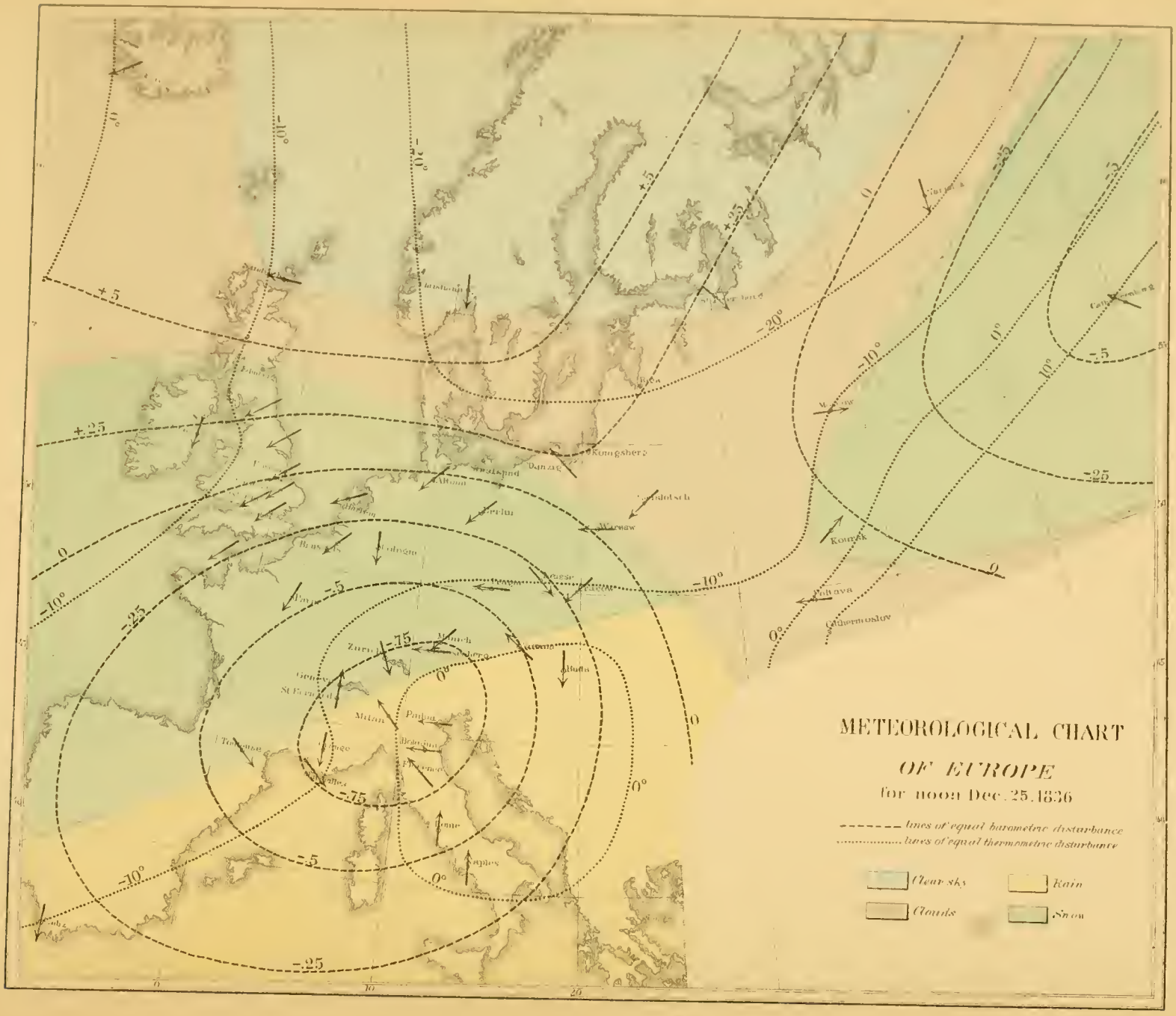


Lith. of J. Bien, 60 Fulton Street NY


METEOROLOGICAL CHART
OF EUROPE
for noon Dec 23 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
+5
+25
-10°
0°
-25
-5
-75
+10°
+30°
-.5
-.25
Riga
Königsberg
Warsaw
Cologne
Paris
Zurich
Milan
Lyons
Nice
Genoa
Brussels
Berlin
Vienna
Cracow
Dresden
Leipsic
Munich
Stuttgard
Strasburg
Bordeaux
Toulouse
Marseilles
Avignon
St Bernard
Piedmont
Bologna
Florence
Rome
Naples
Cape Finisterre
Gibraltar
Algiers
Tunis
Malta
Corfu
Athens
Constantinople
Odessa
Moscow
St Petersburg
Archangel
Stockholm
Christiana
Copenhagen
Hamburg
Amsterdam
Rotterdam
Ostend
Dunkirk
Boulogne
Calais
Dover
London
Oxford
Cambridge
Yarmouth
Hull
Liverpool
Dublin
Belfast
Edinburgh
Glasgow
Aberdeen
Inverness
Portpatrick
Shetland
Iceland
Faroe
Hebrides
Orkney
Cape Wrath
Lisbon
Madrid
Barcelona
Valencia
Cadiz
Gibraltar
Malaga



Lith. of J. Bien, 60 Fulton Street N.Y.


METEOROLOGICAL CHART
OF EUROPE
for noon Dec. 25. 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
+5
-10°
-20°
+25
0
-5
-25
10°
-75
Königsberg
Danzig
Berlin
Moscow
Kazan
Petersburg
Archangel
Wologda
Milan
Padua
Genoa
Naples
Rome
Florence
Turin
Lyons
Bordeaux
Toulouse
Marseilles
Nice
Geneva
Basle
Strasburg
Brussels
Amsterdam
Hamburg
Copenhagen
Stockholm
Abo
Tornea
Wilna
Grodno
Warsaw
Cracow
Vienna
Prague
Dresden
Leipsic
Munich
Augsburg
Ulm
Stuttgart
Frankfort
Cologne
Aix la Chapelle
Liege
Ostend
Calais
Boulogne
Dieppe
Rouen
Paris
Orleans
Nantes
Rochelle
Bayonne
Madrid
Lisbon
Cadiz
Gibraltar
Malaga
Algiers
Tunis
Malta
Corfu
Athens
Constantinople
Smyrna
Alexandria
Cairo
Jerusalem
Damascus
Aleppo
Bagdad
Teheran
Astrachan
Orenburg
Kasan
Nishnei Novgorod
Moscow
Tula
Kaluga
Smolensk
Witepsk
Mohilew
Kiew
Tschernigow
Poltawa
Charkow
Kursk
Orel
Jelatma
Tambow
Penza
Saratow
Simbirsk
Kasan
Perm
Ekaterinburg
Tobolsk
Tomsk
Barnaul
Irkutsk
Jakutsk
Nertschinsk
Selenginsk
Kiachta
Omsk
Petropawlowsk
Semipalatinsk
Ustkamenogorsk
Bukhara
Khiva
Orenburg
Astrachan
Tiflis
Erivan
Kutais
Trebizond
Sinope
Angora
Smyrna
Rhodes
Candia
Cyprus
Tripoli
Tunis
Algiers
Oran
Tangier
Fez
Mogador
Canary Islands
Madeira
Azores
Cape Verd Islands
Cape de Verd
Senegal
Timbuctoo
Bornou
Fezzan
Cyrenaica
Egypt
Nubia
Abyssinia
Sennaar
Kordofan
Darfur
Wadai
Bagirmi
Soudan
Guinea
Ashantee
Dahomey
Benin
Calabar
Cameroons
Gaboon
Congo
Loango
Angola
Benguela
Mozambique
Zanzibar
Mombas
Melinda
Socotra
Aden
Mocha
Muscat
Ormuz
Bushire
Bassorah
Bagdad
Mosul
Diarbekir
Orfa
Aleppo
Antioch
Alexandretta
Tripoli
Beirut
Acre
Jaffa
Gaza
Suez
Cairo
Alexandria
Rosetta
Damietta
Port Said
Jerusalem
Damascus
Tiberias
Nazareth
Jericho
Hebron
Bethlehem
Jaffa
Ramleh
Lydda
Jerusalem
Bethany
Jericho
Jordan
Dead Sea
Sea of Galilee
Nazareth
Tiberias
Damascus
Aleppo
Orfa
Diarbekir
Mosul
Bagdad
Bassorah
Bushire
Ormuz
Muscat
Aden
Mocha
Socotra
Melinda
Mombas
Zanzibar
Mozambique
Sofala
Delagoa Bay
Natal
Port Elizabeth
Cape Town
Cape of Good Hope
Table Bay
Robben Island
Saldanha Bay
Walfish Bay
Benguela
Angola
Loango
Congo
Gaboon
Cameroons
Calabar
Benin
Dahomey
Ashantee
Guinea
Soudan
Bagirmi
Wadai
Darfur
Kordofan
Sennaar
Nubia
Egypt
Cyrenaica
Fezzan
Timbuctoo
Senegal
Cape de Verd
Cape Verd Islands
Azores
Madeira
Canary Islands
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Constantinople
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Sinope
Angora
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Erivan
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Orenburg
Kasan
Perm
Ekaterinburg
Tobolsk
Tomsk
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Irkutsk
Jakutsk
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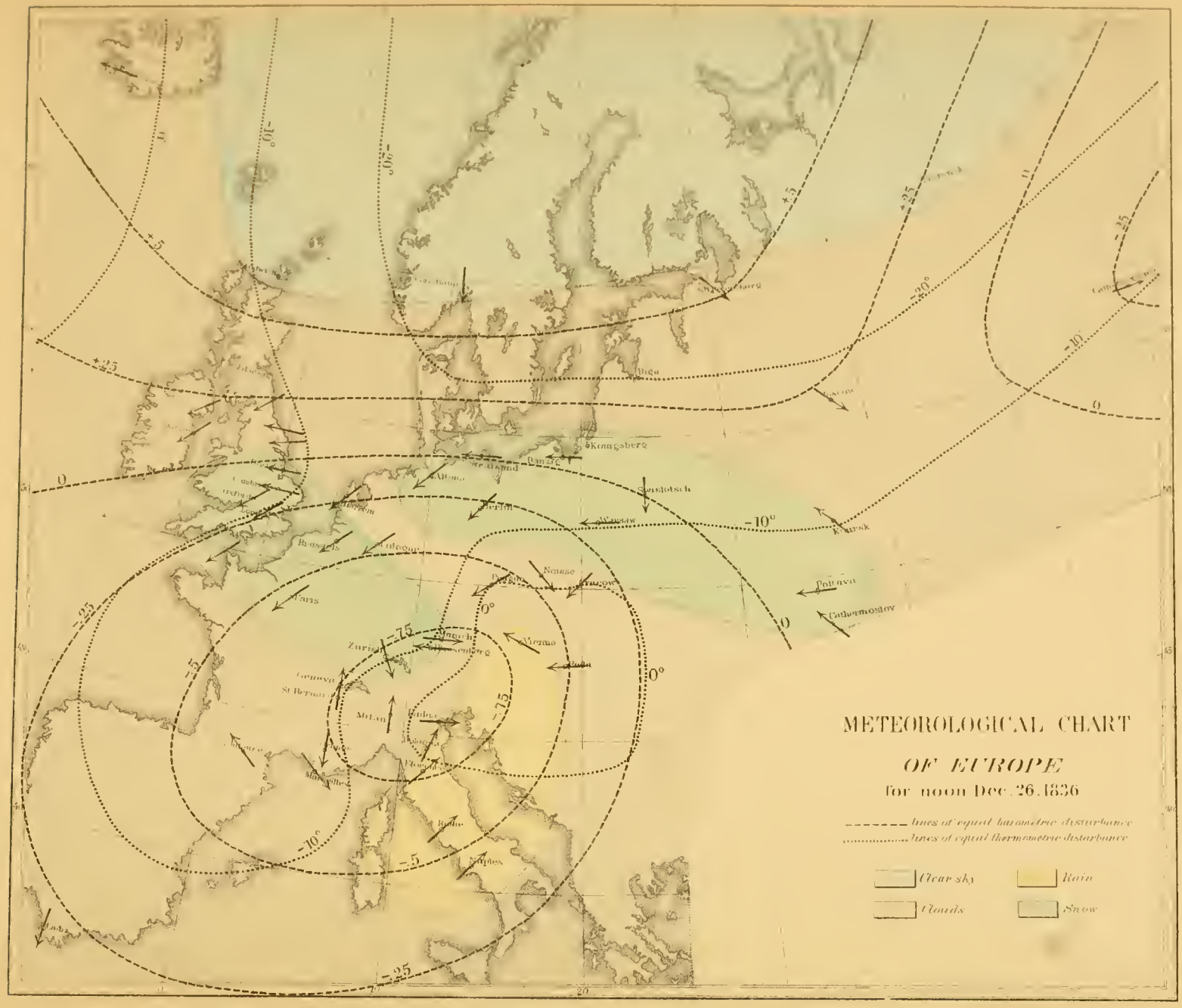
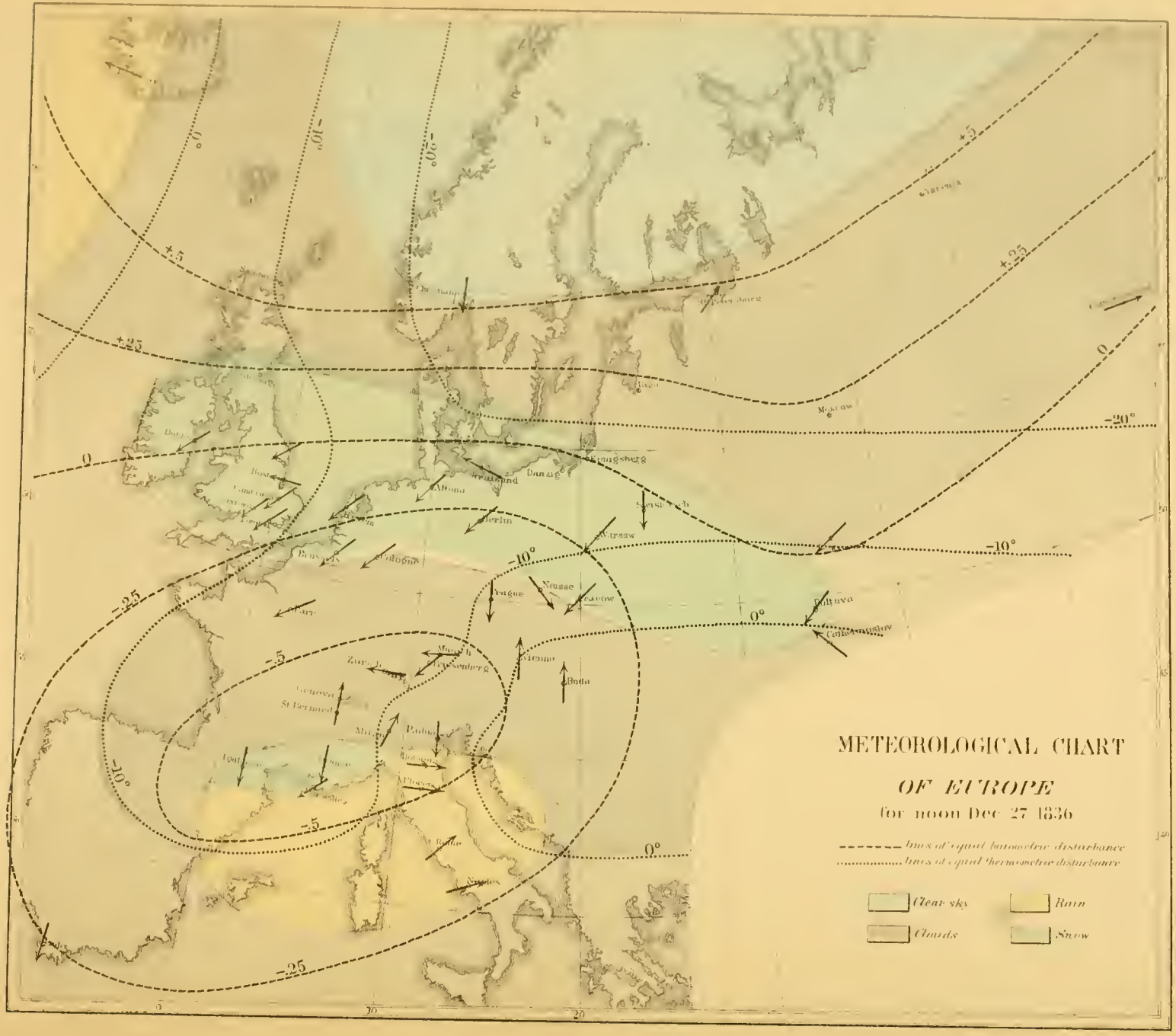
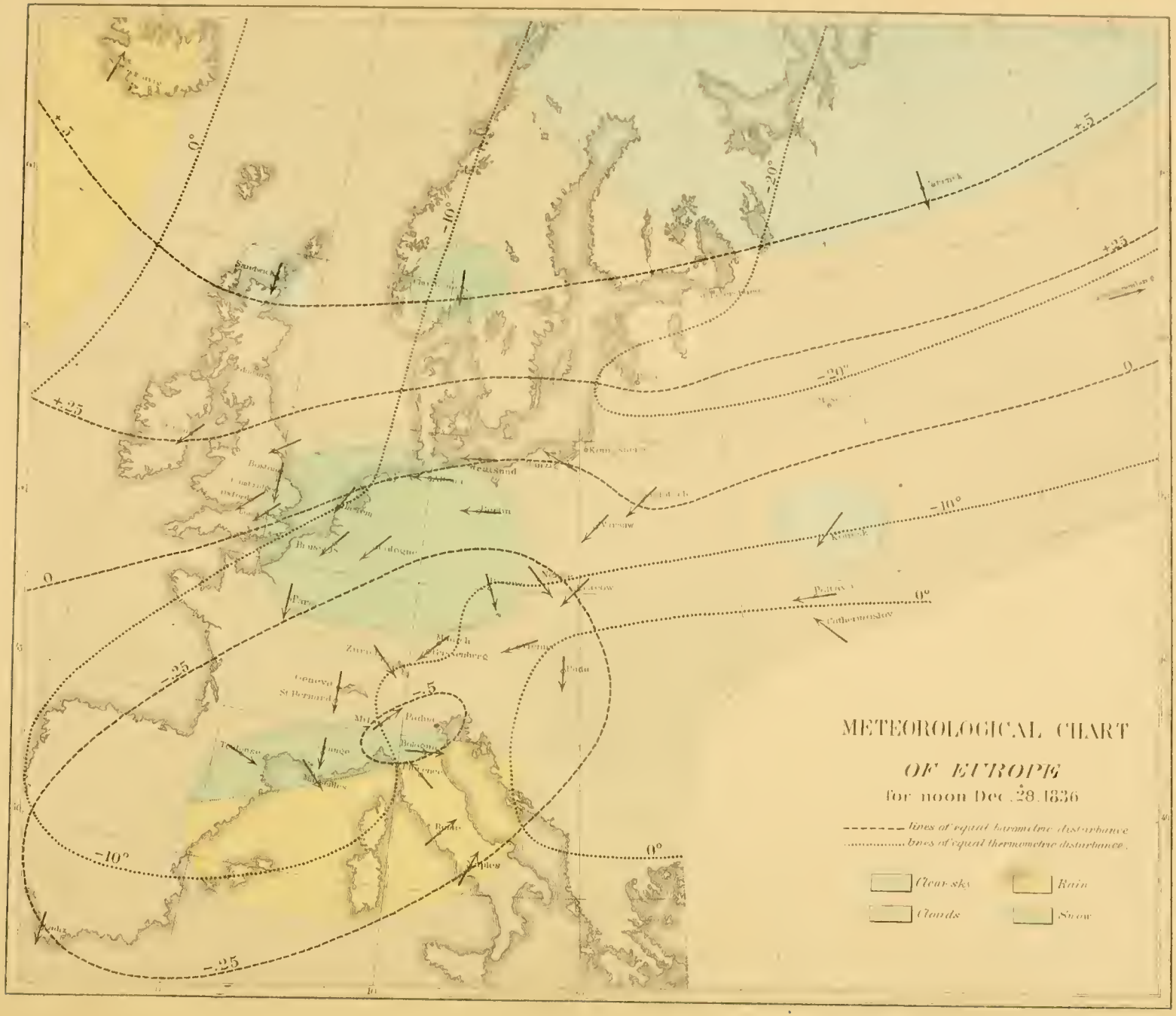

METEOROLOGICAL CHART
OF EUROPE
for noon Dec. 26. 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
Königsberg
Riga
Petersburg
Moscow
Kasan
Archangel
Stockholm
Christiania
Copenhagen
Hamburg
Berlin
Breslau
Dresden
Leipzig
Frankfort
Cologne
Brussels
Amsterdam
Paris
Zurich
Geneva
Milan
Turin
Rome
Naples
Madrid
Lisbon
London
Edinburgh
Dublin
+5
+25
-10°
-20°
-30°
0
-10°
-25
-5
-75
0°


METEOROLOGICAL CHART
OF EUROPE
for noon Dec 27 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
+5
+25
0
-10°
-20°
-25
-5
Königsberg
Danzig
Berlin
Warsaw
Prague
Vienna
Moscow
Paris
Geneva
St Bernard
Padua
Nismes
Buda
Pesth
Cracow
Dublin
Edinburgh
Glasgow
Liverpool
Manchester
Birmingham
London
Bristol
Plymouth
Portsmouth
Brighton
Dover
Cambridge
Yarmouth
Hull
York
Newcastle
Carlisle
Liverpool
Manchester
Birmingham
Bristol
Plymouth
Portsmouth
Brighton
Dover
Cambridge
Yarmouth
Hull
York
Newcastle
Carlisle


METEOROLOGICAL CHART
OF EUROPE
for noon Dec 28. 1836
lines of equal barometric disturbance
lines of equal thermometric disturbance
Clear sky
Rain
Clouds
Snow
+5
0°
-10°
-20°
+25
0
-25
-5

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